AMATEUR WORK

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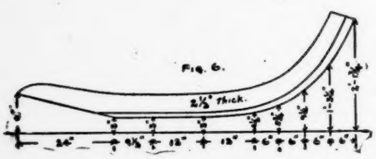
A TWENTY FIVE FOOT AUXILIARY YAWL.

CARL H. CLARK.

I. General Description and Lines.

This boat is designed as a general knockabout boat for sailing, and also to offer fair cruising accommodations for two to four persons. The yawl rig makes her very easy to handle, and the auxiliary power allows her to be handled in calm weather or light head winds. The general design shows a boat with somewhat of a dory model, with a large standing room and a fair sized cabin. The engine is located in the middle of the standing room.

The model is somewhat similar to that of the regulation dory, but is wider and deeper. The dory model gives the best boat for the least work that it is possible to obtain, the single plank bottom and flat stern making the work of construction very simple. The model also is, from the nature of it, a very able one, with good sea-going qualities. The moderate beam makes it easy to drive, thus requiring small sail power and allowing a good speed under engine power. A boat of this type has been found to be exceedingly satisfactory for general sailing and short cruises. The auxiliary feature adds very greatly to the usefulness of the boat, as one may have all the pleasures of sailing and still be relieved of the uncertainty from lack of wind.

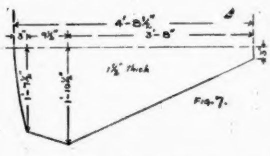


While the model has many of the dory features, the laps of the dory have, however, been dispensed with and the smooth seam construction used instead, as it is more durable and more yachty in appearance.

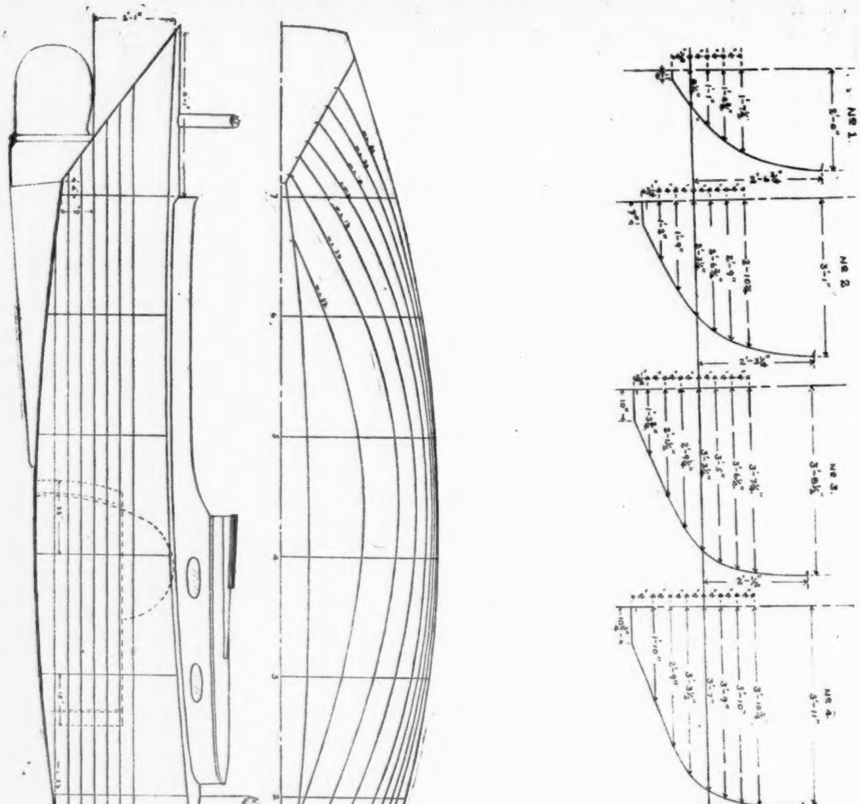
The yawl rig is fitted and she should be readily handled by one man in almost any kind of weather. The engine, also, is of a size to give her a fair rate of speed under power alone.

The cabin is arranged with a wide transom on each side of the centerboard trunk, and cooking and toilet arrangements forward, allowing two or even four people to cruise in comfort.

This boat is so simple to build that there is no reason why it should not be undertaken by any one having the ability to properly use carpenter's tools.



Figs. 1-2 3, show the ordinary drawing of the lines, which is put in to give a general idea of the shape of the boat and to aid in laying it out on the floor. It will hardly be necessary to lay out the entire boat on the floor, as the detailed measurements of the moulds are given in Fig. 4. These moulds should however, be each carefully laid out full size on a smooth floor or large piece of paper. The dimensions given are to the exact size of the moulds, the thickness of the plank having already been deducted. A mould, or form, must now be made to the shape of each mould. The method of construction of the moulds is as shown in Fig 5; any rough stock may be used, but they must be accurate to shape. The center line should be marked on both lower and upper cross pieces for use in setting up. Fig 6 shows the outline of the stem with all necessary dimensions for laying it out. The stern board is also shown in Fig. 7, one side only being shown; this can, of course, be easily duplicated for the other side, paper patterns of both should be made. The actual construction work will be begun in the next chapter.



LINES AND MOULD DIMENSIONS OF TWENTY FIVE FOOT YAWL.

MACHINE FOR GRINDING TELESCOPE SPECULA.

W. FORGAN.

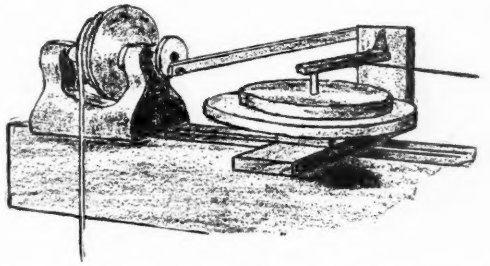
The simple addition to an ordinary lathe for the purpose of grinding telescope specula has been of so much benefit to the author that it was thought, if made known through the medium of the Society of Arts, it might become useful to others interested. Up to about fifty years ago the whole of the specula of reflecting telescopes were made of what was termed speculum metal, a composition of copper and tin in the proportion of their chemical equivalents. This metal, when highly polished, is stated to reflect only about 65 per cent of the incident light. Just about fifty years ago Liebig made known his method of reducing nitrate of silver to the metallic form by means of grape sugar. The silver thus thrown down is pure, and when polished, authorities state it reflects over 90 per cent of the incident light.

A mirror having upon it a film of pure silver will be seen to possess a very great advantage over one of speculum metal. A mirror made of speculum metal may in the course of time lose its luster and polish, and require to be again polished. This may result in the original figure being destroyed and lost. When made of glass and silvered on the face by Liebig's process, the silver may, and no doubt does become oxidized in the course of time; but the silver has only to be dissolved off, and the mirror resilvered as often as may be necessary, without affecting in any way its original figure.

The construction of mirrors made of glass very soon became general after Liebig's process was known. The first to make them was Dr. Steinheil, of Munich, in the year 1857, and about the same time Foucault of Paris, and Draper of New York, also made glass specula. The construction of glass specula has now become very general among amateur astronomers, and it is with the view of showing how very simple an addition to a lathe may be effective for that purpose that the present communication is made.

Before describing briefly the machines used in grinding mirrors, it may be well to indicate the first step of all. Take, for example, the tool necessary to construct a speculum whose diameter is 6½ in., and focal length, say, 5 ft. 6 in. This is a size to which those beginning such work might do well to restrict themselves. The first thing is to make two grinding tools—a convex and a concave—each having a radius of curvature of 11 ft.

A templet must be struck by means of a long wooden rod, through one end of which a nail or bradawl is passed into the floor, and at the distance of 11 ft. another nail or cutter of some sort makes a circular mark or cut upon a piece of zinc or brass 6½ in. broad, lying on the floor. When the metal is cleanly separated by clipping and filing at the mark, we have two templets—a convex and a concave. A piece of board is then placed on a lathe chuck and turned on its opposite faces to correspond to the above templets, and 6½ in. in diameter. Two castings are then obtained either in iron, brass or zinc, from this pattern and worked upon each other, the convex surface of the one into the concave surface of the other, until either by turning, filing or grinding, they fit each other perfectly.



The convex surface of the one is cut into squares with a file, the grooves so cut being about ½ in. apart, the depth of the grooves being immaterial. This is all the preparation necessary previous to beginning the operation of grinding. The most perfect system of grinding is that in which the whole operation is done by the hands alone. But hand-grinding is so laborious, slow and fatiguing, that almost everyone desires the assistance of a machine of some kind to lighten his labor. Now, it may be stated that no machine has ever been made or can be made, to grind a perfect speculum by itself. Machines require constant alteration of the stroke during the process, and it is with the view of showing why this is necessary that reference to them requires to be made before describing the simple method devised by the author.

There are three essential things which require to be kept prominently in view to insure success in grinding mirrors, either by hand or by a machine. The first is that in grinding, a true spherical surface must be got. (Sir Howard Grubb states in one of his articles that a true spherical surface is only got by chance.) The second is the length of stroke used, while the third is the side stroke. According to Sir John Herschel, the second and third seem to be essential. A beginner will have much difficulty with the first, less difficulty with the second, but the third is the most important of all.

Reference is here only made to the case in which the tool is made to work over the speculum either by strokes entirely straight, or partly straight and partly

circular. While the speculum is slowly revolving on the machine, the grinder is caused to move across the speculum at a short distance from its center; this movement constitutes the 'side stroke." If this were not done, and the center of the grinder pass invariably across the center of the speculum, a truly sperical curve could not be obtained, and the center would be ground down much more than it ought to be.

Another point requires to be mentioned in reference to machine grinding. The motion of a machine is regular, and at certain times the strokes of the grinder recur oftener at certain places than at others, giving rise to nodes and, of course, causing a circular groove or zone in the speculum at these points There may be one or more of these zones. Thus, if the machine causes its strokes to meet with regularity at a definite point, there will be a depression at that zone all round the mirror, and instead of a circular curve there will be a wavy form; a speculum with such a surface will naturally be of no use. It is difficult to see these defects until the mirror is partly polished, when they are at once detected by reflected light. By a skilful and judicious use of the side stroke, a mirror can be made without any zones.

It occurred some months ago to the author that this difficulty of the side-stroke could be got rid of in the case of small specula up to, say, 8½ or 10 in. in diameter by using jointly the lathe and the hand motions, and he believes that he has been successful. The drawing of the simple addition to a lathe is subjoined. It will be seen to consist of a board 1 in. thick, 3 in. broad, and 15 in. long, firmly bolted down to the lathe bed. A short upright piece is attached to the off-end by two strong iron hinges which allow it to swing forwards and backwards through the action of a wooden rod attached to a crank-pin fixed to a chuck on the lathe mandrel. The other side of this upright piece has a wooden rod which engages with a pin on the back of the grinding tool. A cord passes from the small groove on the lathe-wheel, which is 1 ft. in diameter, to a 6 in. wheel in the mandrel, and when the lathe is worked the grinding tool is made to move across the speculum by means of the two wooden arms.

The crank is set so as to produce a motion of one-eighth the diameter of the speculum, which rests upon a piece of thin wood somewhat larger than its diameter, and while the motion of the lathe continues this piece of wood is turned round more or less by the left hand, either backwards or forwards, thus giving an irregular motion of the very best kind, superior in every way to a mechanical one.

Now, if this were all, any number of zones would be the result, and this has been found to be so in actual practice. These are got rid of in a very simple way. A piece of string is hooked on to a nail in the middle of the wooden rod which drives the grinder, while the other end is attached to some fixed point. The string allows the center of the grinder to pass over the center of the speculum; but to get the side-stroke the the pointer finger of the right hand is pressed on the string more or less, and the grinder in this way can be moved while the lathe is running, to the necessary extent off the center of the speculum, and thus obtain the necessary side stroke in the very simplest possible way.

The stroke is a straight one; but notwithstanding this, the motions given by the actions of the two hands entirely eliminate the zones, and the result is a nearly spherical surface if, indeed, it is not as true a one as can be desired. Two specula, each of 6¼ in. diameter have been ground in this way, and the results given by them are exceedingly good. They are still unsilvered and, of course, reflect somewhat under 5 per cent of the incidental light; but they undoubtedly show both by trial on stars, on the moon and Jupiter, that the movement forms a means of obtaining a nearer approach to the spherical surface than can be obtained in any other way.

It may be thought that too much has been said about obtaining a spherical curve; but it seems to be the foundation, and the correct one, for getting the necessary parabolic one. The difference between a parabolic and a spherical surface is so small that it is assumed by most that the conversion to the parabolic form is got in the polishing. Mr. Ritchey gives in his Memoir the difference in regard to some mirrors, and these are in decimals of an inch:

1.	His own 2 ft., of 93 in. focus	.0004
2.	Lord Rosses 6 ft. of 60 ft. focus	.0001
3.	The Yerkes 4 ft. mirror of 25 ft. focus	.0006

It will be seen from these figures that in the first one the difference is only 4-16 000 of an inch, an amount which it seems could without difficulty be removed in the polishing after a true spherical surface has been obtained.

The lathe runs so easily with the grinder and acts so rapidly with the motion that when it is making 120 strokes a minute a 6¼ in. polished speculum can be put on the machine, the top portion ground with flour of emery and made ready for polishing again in about an hour. The two 6¼ in. specula which are at present used were treated in that way.

Most of the obelisks in existence were taken from the quarries of Syene in Upper Egypt, and are of red granite or syenite They are the monolyths of the ancients. Some of them measure over 100 feet, and to extract a vast piece of stone of this size meant great care and toil. At Syene an unfinished obelisk shows the way they were cut. The obelisk was cut out of the solid rock and polished on three sides before the fourth was disengaged. A deep fissure was then made along the under side, where the separation was to be made, and wooden wedges introduced into it, which being frequently moistened, expanded and gradually effected the separation without any shock.

MINIATURE GRANDFATHER'S CLOCK.

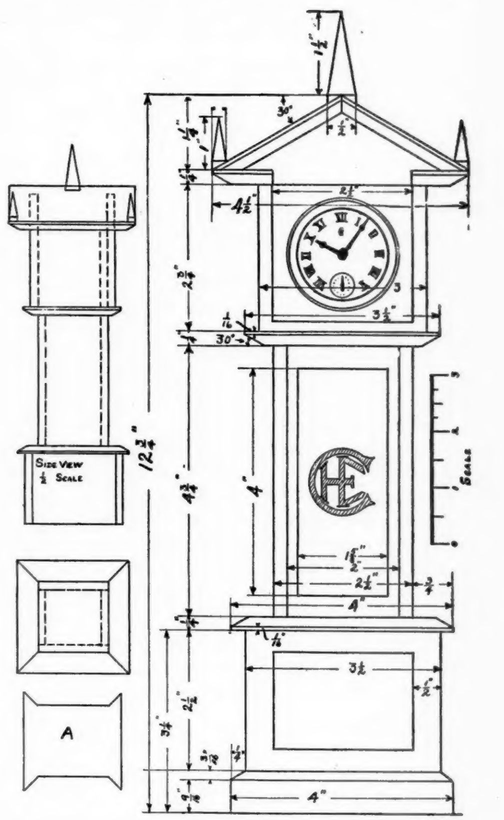
IRA M. CUSHING.

The clock illustrated and described makes a very pleasing gift, and well repays the maker for the time and small expenditure given to it. The drawing given is well dimensioned as well as drawn to scale. The material used will depend somewhat upon the finish desired and upon the maker's resources. A nicely grained maple or quartered oak finished with a Flemish or weathered oak stain or a mahogany stain give a very fine effect. However, the clock can be made of cigar-box wood, filled and stained.

The base should be constructed first, making it 3½ in high, fastening the baseboard on outside. The top of the base should set into the box flush with the top of the sides. It should be fastened in well as this supports the rest of the clock. The bottom should be top put in before fastening the baseboards in place. It might be well to wait until the middle section is in place before putting in the bottom piece. The caps of the base should now be put on This will leave a space 2¼ in. square and ¼ in. deep on top the base into which the middle section will fit.

The middle section will be a box 5 in. long. The bottom of it should fit inside and should be fastened in rigid. The top of this box will also constitute the bottom of the clock section, and should be cut as shown at *A*. The sides cut out should be filled in with pieces which have the grain running at right angles to the top. This will follow out the scheme of the base and give a uniform appearance on all sides. If desired, the front panel of this middle section can be fitted with hinges and a lock, making a good jewelry case. The middle section can now be assembled with the base by small screws, or nails and glue, through the bottom into the top of the base.

The clock section is another box 2⅝ in. long and 3 in. square. The front should set in about ¼ in. and the diameter of the hole for the clock will, of course, depend upon the clock purchased. The back of the clock section should be made removable. The neatest method is to use hinges and a thumb catch to fasten it. The method of fastening the clock in place will also depend upon the shape of the clock and will be left to the ingenuity of the maker. It should, however, be easily removable for cleaning and repairs. The bottom of this section should be set in and the assembling done the same as the base and middle sections. The roof is made next and is 4½ in square at the eaves. This should be made removable for access to the clock. The best way is to put hinges at one side and a hook and pin at the other. The hook should hang and fasten on the clock section. If it were on the outside it would detract from the appearance of the inside of the clock. The pinnacles on the roof have a square cross section. After all parts have been assembled the clock should be sandpapered, taking care not to round the edges. Leaving these edges and corners sharp add very much to the general appearance, and the clock will resemble more nearly the old colonial clocks.



I would suggest that thin glue and small wire brads be used to make the clock. Care should be taken that all joints fit even, and that all parts are symmetrical. Inequalities show up very quickly in a small piece like this. I think it would be well to put a weight, like a piece of lead in the base. This would prevent the clock from tipping too easily. It can be put in the last thing, just before fastening the bottom in, and should be securely held in place.

A number of little things could be done to add to the beauty of the clock. The front of the base and middle section could be paneled, as shown on the drawing. Small wooden balls could be added to the

top of the pinnacles. The value of the clock to the one to receive it would be much increased if, in paneling the front of the middle section a simple monogram of the recipient's initials was left raised. The drawing shows H. E. C., worked into a monogram. Then, when the clock is stained, more of the stain should be rubbed off the letters, leaving them lighter than the surrounding wood. If a door is made of the front the inside may be lined with plush of appropriate color and hooks put up for hanging jewelry.

BOOKS RECEIVED.

A First Course in Physics. Robert A. Millikan and Henry G. Gale. 488 pp. 7½ x 5 inches. 461 illustrations and several portraits. Price $1.25 Ginn & Co., Boston.

This one year course in physics has been developed from the experience of the authors at the School of Education of the University of Chicago, and in dealing with the physics instruction in affiliated high schools and academies. The book is intended for third year high school pupils, and is a simple, objective presentation of the subject as opposed to a formal and mathematical one. The historical aspect of the subject is treated in a most interesting way, enabling the pupil to obtain an excellent perspective of the development of the science.

The text throughout is exceptionally clear and the various topics are presented in a most interesting way, having the life and spirit well calculated to arouse and sustain the interest of the pupil.

All the experiments in the book have been carefully chosen with reference to their usefulness as effective class-room demonstrations. It would certainly seem impossible to have a dull, lifeless class when this book is used.

Designs for Small Dynamos and Motors. Cecil P. Poole. 186 pp. 9¼ x 6 inches. 231 Illustrations. Price $2 00 McGraw Publishing Co., New York.

Most of the chapters of this book originally formed articles written for the "American Electrician" and many of them are included in "Electrical Designs" a book published by the same publishers. Twenty-two designs of various types and sizes of motors and dynamos are given, of which eleven are one-horse power or under. The text is confined to specific directions about each machine and does not include any theoretical matter.

Anyone wishing to make eleccrical machines of the types described will find the book of much value.

Handbook of Mathematics. T. Claudel. Translated by Otis Allen Kenyon 708 pp. 9¼ x 6 inches. 422 illustrations. Price $3.50. McGraw Publishing Co., New York.

This book is intended primarily as a reference book for the mechanic, engineer or teacher, but it is also well adapted to home study for anyone desirous of quickly learning some particular mathematical process needed for work in hand. Owing to the wide scope of the book only essentials are given, but this is what makes its greatest value for the purposes mentioned. With the exception of a few pages in life insurance, which follows the French methods, the processes are in accord with the accepted American practice. In France the book has quickly passed through seven editions, and an equal success is predicted for this country.

ELECTRICITY ON THE FARM.

Although applications of electric lights and power to farm work are few and widely scattered, occasionally conditions which permit of one or both of these applications are readily seized. An instance of this kind was recently reported from the agricultural state of Nebraska. Three farmers, having combined and installed a small gasoline engine for pumping purposes, embraced the opportunity to make further use of this engine when it was not pumping water. They secured a small dynamo, and placed it so that it could be driven from the engine. They then installed electric lights in their houses and barns, so that now they are enjoying one of the luxuries of country life—a safe, convenient and economical light.

In spite of its backward state, the application of electric power on the farm is sure to develop rapidly before long. At the present such uses are limited generally to the estates of so called gentlemen farmers, who farm for pleasure rather than for profit. A drawback to the wider use of the motor is its first expense; but if farmers would form groups, as has been done in the instance mentioned above, and divide the cost of the machinery among them, this objection would no longer hold. The machinery needed for such an arrangement is not large; in fact, it need hardly be larger than that required for a single farm.

The principle of the rifled gun has been applied to pipes for pumping oil in California, where the crude oil is mostly thick, viscous and difficult to pump through long lines. The pipe is rifled on the inside, so that the oil, mixed with about 10 per cent of water, is caused to whirl rapidly. The water, being heavier than the oil, seeks the outside, and forms a thin film, which lubricates the pipe for the passage of the oil. The friction is thus so far reduced that the oil has been easily pumped through a line 31 miles long.

In anticipation of the large demand for alcohol for light, heat and power, preparations are being made for the erection of plants through the South to work up the mountains of sawdust made at the sawmills. The first plant, using a new mechanical process and costing $250,000, is nearly completed at Hattiesburg, Miss.

NURSERY FURNITURE.

JOHN F. ADAMS.

In response to a number of requests for furniture "for the children," a few pieces likely to be most in demand are given with the hope that a large number of children will enjoy their play as much as have the little ones who possess the articles from which this description is taken.

And quite as important as any single piece of furniture is the

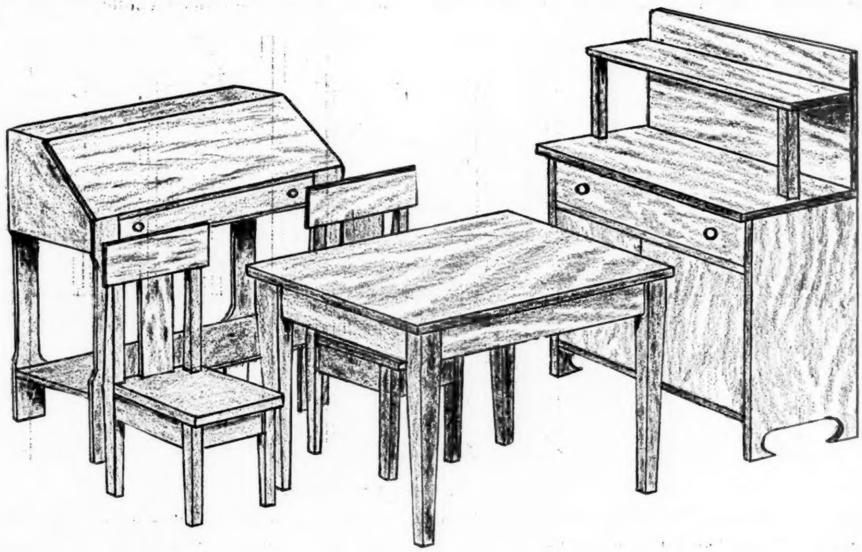
FOLDING SCREEN PLAYHOUSE,

which adds such a touch of reality when playing "house." Nor is it entirely a plaything, as on windy and cool nights it serves as a screen against drafts. As it can be quickly folded up and put away in a cupboard, it is in that respect superior to a wooden one, and has the great advantage of being usable throughout the year, and especially on stormy days.

The framework is made of spruce strips 1½ in. wide; 12 pieces 5 ft. long and 20 pieces 3 ft. long being needed. Both doors and windows are hung with hinges and similar strips 1½ in. wide and 3 pieces 6 ft. 6 in. long; 12 pieces 30 in. long and 9 pieces 18 in. long are needed.

The screen is made in four sections, each 5 ft. high and 3 ft. wide, and fastened together with hinges so that the two end sections swing towards the back and the middle joint the reverse. The three sections having windows are alike, the other sections having a door. The framing of the window and door are fully shown in the illustration. Joints should be carefully made using mortise and tenon pretty generally throughout the frame. Across the top of the windows and doors nail strips 3 in. wide and about ½ in. thick, which make a better representation of the frame and also serve to prevent door or window from swinging by.

The framework being completed, it is covered on both sides with extra heavy wrapping paper, or light cardboard, using glue liberally for the purpose. On this covering is put red cartridge wall paper, which is lined off to represent brickwork with white paint, the thin pieces over the door and windows covered with gray cartridge paper to represent stone cap pieces. Or a wooden house can be represented by getting a roll of wall paper showing strips of sheathing, this pattern being frequently put on a kitchen. The light strips are cut out and pasted on in horizontal layers, to show as clapboards, and the dark strips run vertically at the corners and around the doors and windows to form the casings. The door is also made up from the same paper, the lighter strips forming the panels and the darker one the styles and rails. The glass in the windows can be nicely provided for by using transparent card stock, obtainable at paper houses handling card stock for printers, and ordered through a local printer, who would be willing to have it come forward with an order of his own. Other schemes of decoration will undoubtedly suggest themselves to the reader, but those given are probably the easiest to make up in most localities.



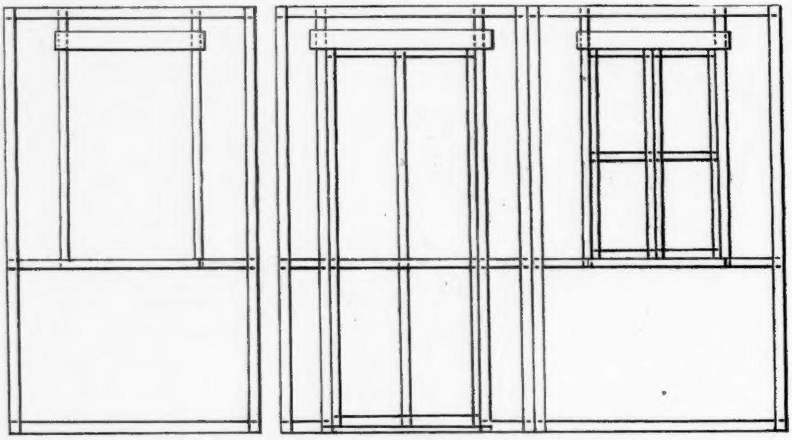
Having a house, the next thing is to furnish it, and for this two chairs and a table will be needed, and a sideboard, desk and other fittings can be added if the interest of the reader, and the wishes of the children do not conflict with each other.

THE TABLE

has a top 20 in. long, 16 in. wide and $\frac{7}{8}$ in. thick. The four legs are 22 in. long, $1\frac{1}{4}$ in. square at the top and 1 in. square at the bottom. The longer pieces connecting with the legs are $2\frac{1}{2}$ in. wide and $16\frac{1}{2}$ in. long, which allows $\frac{1}{2}$ in. at each end for tenons. The pieces at the ends are $12\frac{1}{2}$ in. long, with the same allowance for tenons. The mortises in the legs are centered and are $\frac{5}{8}$ in. wide and 2 in. deep, being open at the top.

THE CHAIRS

are of simple construction, and have seats 12 x 10 in. and $\frac{3}{4}$ in. thick. The front legs are 12 in. long, $1\frac{1}{4}$ in. square at the top and $\frac{7}{8}$ in. at the bottom. The



FRAMEWORK OF PLAYHOUSE.

rear legs are 2 ft. long and $4\frac{1}{4}$ in. square at the center, tapering off at the bottom the same as the front legs and at the top remaining the same width but thinned down to $\frac{3}{4}$ in. thick. The rear corners of the seat are cut out to fit around them. The cross pieces under the seat are $1\frac{1}{4}$ in. wide, $\frac{3}{4}$ in. thick and $9\frac{3}{4}$ in. long, allowing $\frac{5}{8}$ in. for tenons. The joints must be well made and secured with glue and screws. The top piece of the back is 3 in. wide, $\frac{3}{4}$ in. thick and 12 in. long. The center piece at the back is 4 in. wide, $\frac{5}{8}$ in. thick and 10 in. long, the lower end being fitted to a slot cut in the seat, and fastened with screws which serves to give needed strength to the back.

THE DESK.

This will require a little more skill than the previous pieces, but if care be taken in the work, no great difficulty should be experienced. The general dimensions are: Height, 3 ft.; width, 2 ft., and depth, 14 in. Whitewood or red gumwood are best suited to secure a light, attractive desk. All except the wood used for the pigeon holes is $\frac{3}{4}$ in. thick. The pigeon holes are made of $\frac{1}{4}$ in. stock.

The top is 24 in. long and 6 in. wide, the drop lid 24 in. long and 14 in. wide; the top over the drawer $21\frac{1}{2}$ in. long and $13\frac{1}{2}$ in. wide, the lower shelf 24 in. long and $12\frac{1}{2}$ in. wide. The dimensions of the front and back legs and deck ends are given in the illustration. The pieces under the shelf are 16 in. long and 2 in. wide, allowing $\frac{3}{4}$ in. at the back for tenon. The drawer is 18 in. long, 3 in. deep and 13 in. wide. This may be omitted and a plain piece substituted, which would be 19 in. long and $4\frac{1}{2}$ in. wide, allowing $\frac{1}{4}$ in. on end for tenons. The shelf is 9 in. above the floor. The grain of the ends of the desk runs vertical.

THE SIDEBOARD.

To complete the appointments of the house, and enable the children to play with all possible resemblance to "grown ups" a sideboard may be added to the pieces previously described. The general dimensions are: Height, 3 ft.; width, 27 in.; depth, 12 in.

The ends are 2 ft. long, and 11 in. wide with the lower ends cut to the shape shown in the illustration; the height of this cut is 3 in. The top is 27 in. long and 12 in. wide and the board at the back is the same size. The shelf is 27 in. long, and 5 in. wide and rests on posts 1 in. square and 8 in. long. The posts are attached to the top by short pieces of $\frac{3}{8}$ in. dowels, boring holes for same in both posts and top and setting up with glue.

The back board is attached to the cabinet by means of cleats 2 in. wide fastened with screws and long enough to reach 6 or 8 in. down on the back of the cabinet. The bottom of the closet is 24 in. long and $10\frac{1}{2}$ in. wide, the under side set even with the upper edge of the openings in the ends.

A drawer may be made as shown or the whole space under the top may form a cupboard. If a drawer be made, it should be 24 in. long, 3 in. deep and $10\frac{1}{4}$ in.

wide. A rectangular frame is made for the runs for the drawer, the front strip being 1 in. wide. This makes the size of the doors 16 in. high and 13 in. wide.

A strip about 1 in. square and 24 in. long is nailed to the under side of the back of the top piece, set in from the back edge ½ in. and the back sheathed up with ½ in. sheathing. The ends of the sheathing are nailed at the top to the strip just mentioned, and at the lower ends to the bottom of the cupboard. Suitable knobs and catches are added to the cupboard doors and drawer pulls or knobs to the drawers.

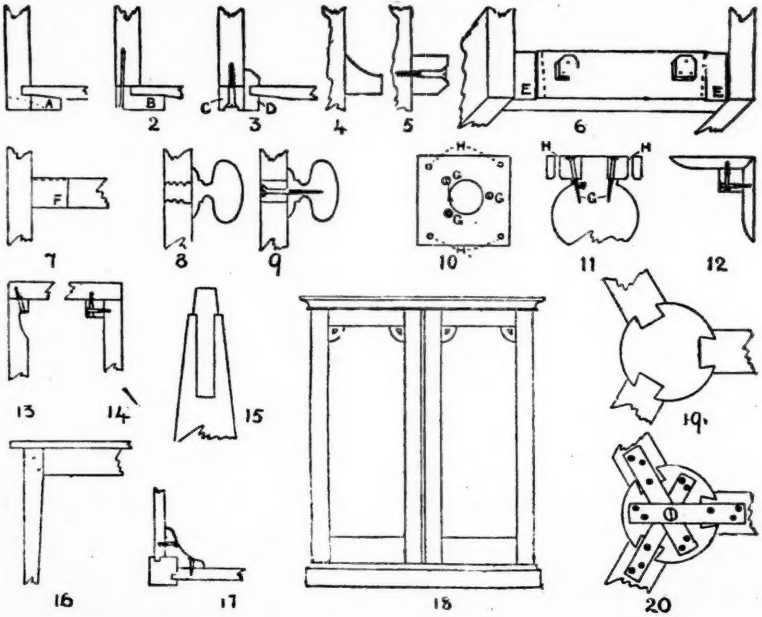
The preferable finish to all the furniture described is weathered oak or dark brown stain and varnished, as the pieces are all in the old mission styl. A word of caution to those using stains for the first time is: Do not use too much stain. Apply a little at a time, and with a soft rag rub off the excess stain until the grain shows clearly. Dark stains are likely to conceal the grain after drying more than they appear to when moist.

REPAIRING FURNITURE.

In the present article we will endeavor to show how some at least of the ills to which all articles of furniture are liable may be remedied, and we cannot do better than make a start with drawers, the constant wear and tear of these, to which in many cases, may be added ill usage, making them particularly liable to get out of order.

When new, the running corner of a drawer is, or should be, as Fig. 1, but sooner or later, according to the material, or whether fitted properly or not, the nails at the back and carefully uplifting away the runners, *A* Fig. 1, then cut away the sides to the extent of the groove in which the bottom slides, and fix on with nails and glue, rebated strips as *B* Fig. 2. These strips should be of hard wood, and it is necessary that they fit well at the joint, otherwise the glue will fai to hold properly, and it will not do to depend on the nails alone.

In case the foregoing method proves too difficult for some of our readers, we give in Fig. 3 an alternative,



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

side wears off as shown by dotted lines, and when this wear has once commenced, it goes faster, until the drawer can only be used with difficulty, and the longer it is used in this condition, the worse job it is to repair satisfactorily.

The proper method of repair is shown in Fig. 2. First remove the drawer-bottom by withdrawing the in which the sides of the drawer are planed off in the same way, but instead of fixing on rebated strips the width of the side strips, as *C*, and after these are dry the grooved strips *D* are glued and screwed on inside the drawer, the bottom of the latter being reduced in size, so as to slide in these new grooves, as shown.

At all times when the drawers are worn as above, the bearers on which they run will be found to be in the same state as shown in Fig. 4, the remedy is to remove the worn part and renew, as shown in Fig. 5. This is, as a rule, comparatively easy to do, but it is absolutely necessary that the top of the new bearer should be at the same height as the old one was when new.

In addition to the drawer runners and bearers being worn away, the front rail, where there is one, is also likely to be affected, as at *E*, Fig. 6. To remedy this, cut away to an even depth and insert pieces of wood of the required thickness, covering them at the front by letting in pieces of veneer neatly, as *F*, Fig. 7. These latter will fit better if made slightly taper, as shown; they can then be driven in as a wedge.

Knobs on drawers and cupboards have often a tendency to work loose, especially when screwed in as in section Fig. 8. A simple and effective remedy is to remove the knob and cut off the screwed portion, also clear out the hole in the drawer and glue in a well-fitting ply of hard wood. When this is dry, clean off level with the surface of the drawer front both inside and out, and then fix on the knob with a long slight screw, as Fig. 9, just touching the face of the knob with glue to prevent it working off by unscrewing.

The turned feet with which chests of drawers are often fitted have a bad habit of getting loose, owing to the shoddy method of fixing. The foot proper is, as a rule, fitted into a block of soft wood, which speedily splits off and off comes the foot. The remedy is, make a block of hard wood, as Fig. 10, screwing through it into the foot with three screws *G*, and then fixing to the chest with four screws at the corners, as *H*. This is shown sectionally in Fig. 11, and it will be found a firm, substantial job.

Instead of the turned feet, two shaped pieces at right angles are sometimes used, and as these are too often simply glued on, they will not stand much rough usage. They may be, however, improved by screwing through the angle block, as in Fig. 12, and can also be prevented from leaving the drawers by fixing with screws as Fig. 13, or with another angle block, as Fig. 14, using glue as well in each case.

Castors have a bad habit of becoming loose and after being re-screwed a few times, there is no wood left to fix to. An effective remedy for this is to cut off what is left of the spigot, bore down into the leg and insert a piece of wood with a new spigot turned on the end, as Fig. 15; if this latter is made to fit and fill the socket of the castor entirely, there will be no difficulty after, the whole of the original fault lying in the fact that when the castors are fitted at first, the wood does not fill them, thus allowing a certain amount of free play, which increases more and more, putting all the strain on the small screws.

Table legs are apt to work loose where they join the rails, either through the pins becoming fractured, or through the leg splitting at the pin holes; in either case they must be forced together and glued, inserting new pins if required, and to prevent a recurrence of the trouble, angle blocks should be fixed on the inside. Fig. 16 shows the position of the fault, and Fig. 17 the remedy.

On removing heavy furniture, especially wardrobes, it is often found that the doors or drawers will not work as they should do in their new position, rubbing at the top or bottom, and much surprise is often felt that it should be so. The cause is in the slightly varying level of the floors, and the remedy is a simple one. Fig. 18 shows a wardrobe in position; now if the left-hand door rubs at the bottom, it is probable that the right hand one will rub at the top, and instead of planing both to make them right, we simply insert a chisel under the plinth at *I*, so as to lift it up, and when the doors swing clear a wedge inserted between the plinth and the floor will make them right. The same remedy applies to chests of drawers and boxes, these latter often locking easily when empty, but when filled will not do so, the reason being that the weight of the contents brings the bottom of the box to the floor, displacing the catch of the lock slightly, a fault which a slight wedge will correct at once, far more quickly than altering the catch itself.

Tables which are made with a central pillar, from which branch out three claw legs, are often a nuisance owing to the claws giving way and leaving the stem. If these are turned up, the claws will be seen to be dovetailed in, as Fig. 19, and the wood holding the dovetails being only side grain, will stand very little strain, hence the fault. The remedy is to replace the claws neatly as possible, and fix each one with a thin brass or iron strap, as in Fig. 10. All the straps may be fixed with one central screw into the stem, also two small screws, and they must be bent to the shape of the claw and screwed firmly to it, as shown, and this will effectually cure the fault. In addition to tables, music stools are often in need of such a remedy, as above.

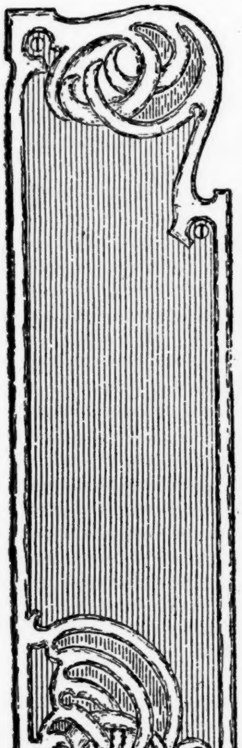
EXPLANATION OF DRAWINGS.

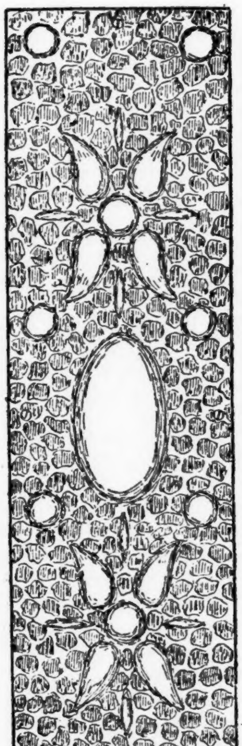
Fig 1. Drawer runner wore away.
2. New runner fitted.
3. Alternative method of fitting runner.
4. Bearer for drawer worn away.
5. New bearer fitted.
6. Front rail worn away.
7. Front rail repaired.
8. Usual method of inserting drawer knob.
9. To refix drawer knob.
10. Refixing foot to chest of drawers.
11. Sectional detail of Fig 10.
12. Strengthening shaped foot.
13. Fixing shaped foot.
14. Alternative method of fixing shaped foot.
15. Inserting new spigot for castor.
16. Faulty joint in frame of table.
17. Strengthening frame of table.
18. Readjusting wardrobe door.
19. Method of fixing claw legs to central stem.
20. Strengthening claw legs.

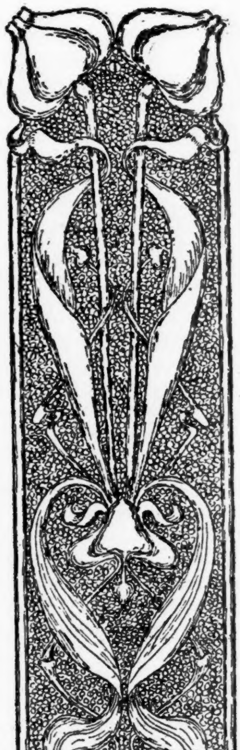
REPOUSSE METAL FINGER PLATES.

EDWIN TURNER.

The finger plate shown in the accompanying illustrations are designed with the object of forming graduated studies for the beginner in repousse metal work. In Fig. 1 is shown a Celtic strapwork design, which can be executed almost entirely with a tracing tool from the front. The ornament in Fig. 2 is raised from the back, and no tracing is required on the front; therefore the design should be drawn on the reverse side. Fig. 3 is more elaborate in design, and in execution will require a combination of the methods adopted in the two other plates.







Cut for each plate a piece of metal 1 ft. by 3¼ in and scour with emery cloth and oil. This done, transfer the designs to the plates, noting that the design in Fig. 2 is to be drawn on the back. Point in with a scriber or tracing point and fix the plate on the pitch-block. Fig. 1 is worked entirely from the front and, with the exception of the ground, which is pushed back with a grounding tool, the work is executed with a steel tracer. To obtain higher relief, the work should be traced a second time with a blunt tracer, tilting the tool in such a way as to force the metal towards the design, thereby causing it to stand out from the groundwork at a sharper and more clearly defined angle. Great care must be taken not to force the tracer through the metal.

The ground should now be levelled down, and al. tool marks carefully worked out, finishing it perfectly flat and smooth all over. The spaces between the strapwork, shaded with the dark vertical lines, are cut out and should now be worked with a sharp stee tracer; also cut out all round the plate with the same tool. Examine to see that all is correct, then remove from the pitch block. Trim all around the edges with

a file and emery-cloth; drill holes for screws; and finish with polish and lacquer.

For Fig. 2, fix on the pitch-block face downwards and commence raising at once. The small end of the mallet should be used at first in the center oval, the edges being afterwards sharpened with brass raising tools. A round brass tool will be found useful to do the other parts. In all cases it is best to use the largest tool that can comfortably be worked in the part to be raised. Remove the plate from the block, turn over and refix, after levelling the pitch-block and cleaning the pitch off the plate. The tool marks in the ground are done with a large raising tool; they should not be too even, but rather irregular. After the ground is finished satisfactorily, remove the plate from the block and thoroughly clean it; then drill the holes for the screws and polish and lacquer.

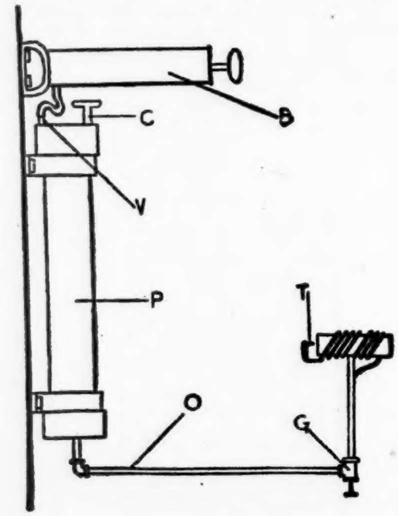
Fig. 3 will require very great care in all stages to insure a good effect. Fix the plate on the pitch block in the usual way and wait until it is cool before commencing the work. Then trace all the lines of the flowers, stalks, leaves and borders of the plate, finishing the treatment of the front by tooling the ground all over with a pearl tool. Take the plate off the block and clean away all pitch that adheres to it; then refix face downwards and raise th design with suitable tools. The illustration will give a fairly correct idea of the parts to be raised, and the amount of relief to be given to each part. The tulips at the top, the leaves and the central figure between the lower leaves will stand out the most prominently, whilst the finer tendrils and buds will only be slightly raised, and will be almost obscured in the background. The border will also require raising. This done, the plate may be taken off the block, cleansed with turpentine and the holes drilled for screws.

If the metal gets bent and twisted in working, it may be straightened by laying it face downwards on the sandbag and beating it straight with the flat end of the mallet. The plate may be greatly improved by again fixing it on the pitch-block, after filling up level all the hollows at the back with the pitch composition, and working round the outline, as in Fig. 1, with a blunt tracer, taking care not to work the ground too low. At this stage any inequalities in the raising should be corrected, and any necessary improvements made. When this is done detach the plate and again clean with turpentine. After this, bring to a high polish with a suitable powder and finish with a coat of lacquer to preserve the polish.—"Work."

To keep machinery from rusting, take one ounce of camphor, dissolve in one pound of melted lard, take off the scum which forms and mix in as much powdered plumbago or black-lead as will give it an iron color. Clean the machinery and smear it with this mixture. After 24 hours rub clean with soft linen cloth. It will keep clean for months under ordinary circumstances.

GASOLINE BRAZING TORCH..

A gasoline brazing torch which fastens to the wall in front of the work bench and swings back out of the way when not in use may be made, says the "American Machinist," as follows: Thread both ends of a 2 ft. length of 2 in. gas pipe. In a 2 in. cap drill a hole to receive a single tube bicycle valve, *V*; drill another hole and tap it to receive a ¼-in. pipe, *C*, 5 in. long, on which weld a piece of iron to form a handle or T for convenience in replacing the piece after filling the



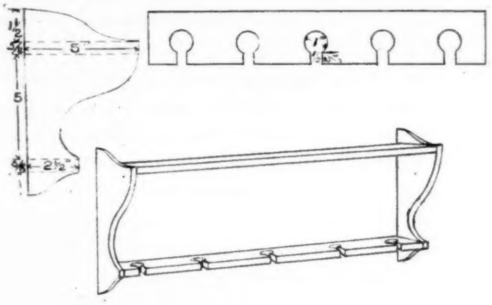
tank by way of the lapped hole. Fit the 2in. cap on the top of the 2 in. pipe. Drill and tap the cap for the bottom for a ¼ in. pipe, *O*, 3½ ft. long and threaded at both ends. Make the burner a piece of bicycle tubing with a 2 ft. length of small sized tubing coiled around it. An angle valve *G* controls the supply of oil to the burner. The arrangement of the burner causes a continuous generation of gas by the blast. Make a hole not larger than a pin prick in the cap, *T*, at the end of the coiled tube. Fasten a bicycle pump *B* to the wall just above the tank in use in keeping up a constant pressure in the tank.

Oil may be prevented from entering the boiler with the water condensed from steam by putting an upward extension on the pipe leading to the boiler, and providing it with a means of tapping off the oil that will rise in the pipe above the horizontal pipe connecting with the boiler.

When anthracite coal is used in boilers, it is necessary to employ wide grates of large area and a comparatively low firebox. When consuming bituminous coal, narrower grates of smaller area and a high firebox are necessary.

PIPE RACK.

As making Christmas gifts is the thought in many minds at this season of the year, a pipe rack is offered as a suggestion to those readers who may have relatives or friends who are smokers. This rack is simple in design but possesses one point of merit lacking in most of them, and that is a shelf wide enough to hold the tobacco jar, match safe, etc., thus bringing all the smoking articles together in one place.

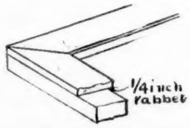


The shape and dimensions of the ends and pipe shelf are shown in the drawings. The upper shelf is 16¼ in. long and 5½ in. wide. If made in bass or pine it may be decorated by pyrography, or made of white wood, maple or mahogany, as desired.

INEXPENSIVE PICTURE FRAMES.

Many persons accumulate in time picture taken from magazines or from other sources, which they would like to have framed but which lack sufficient value to make it worth while to purchase a frame. For such cases the home-made frames here described will be quite appropriate as they are more attractive in the large sizes than the small.

Obtain several cypress clapboards, selecting those having the most distinctive graining. These can be secured from nearly any contracting house builder. The thin edge is then cut off, leaving a tapering strip, the width being determined by the size of the frame to be made.

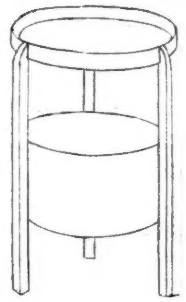


Strips of pine or spruce about ¾ in. thick are then planed up, the width to be about ¼ in. less than that of the clapboards, with the outer edges of both even, a rabbet being formed on the inner edges.

The frame can now be made up as with ordinary picture moulding, the corners being mitred and set up with glue, drying between the clamps. The frame is then stained to any desired shade, dark green, brown, gray or mahogany being attractive; in fact, about any color can be used that will harmonize with the room in which the picture is to be hung. The final finish may be dull, using a wax; or bright, using shellac and varnish. Anyone having skill in applying gold or silver leaf can use it in place of the stain, making a very attractive frame.

CHEESE BOX SEWING STAND.

An ordinary cheese box and four pieces of wood 1 in. square and 30 in. long are the materials required to make a very serviceable work stand, having the much desired storage capacity for small articles on the top, and a sizable receptacle for the work underneath.



As the box is of somewhat less diameter than the cover, the top ends of the legs, which may be three or four in number as preferred, are cut out, and also rounded off, as shown in the illustration. Long round hard wood screws are put through to secure the legs to the top, and also the bottom part. In addition, several short screws are put through the sides of the lower box from the inside.

The table may be finished by staining and varnishing, provided the box is an attractive one and has been nicely smoothed up. Otherwise, a covering of light, figured cloth will be preferable, although wall paper can be used to good advantage. This part of the work is left to the artistic skill and resources of the reader.

The element of power is the most vital of any that enters into the cost of the manufactured article, therefore, the constant endeavor has been and is, to produce power at the lowest cost. The enormous loss which lies in the conversion of coal into work is due to the large number of transformations which the thermal units are obliged to pass through before the desired result is obtained. Fuel burned directly at or in the engine has been found to accomplish the purpose by reducing the number of intermediate transformations. This type of engine is the gas engine, which has now reached the point of economical and satisfactory operation.

AMATEUR WORK.
DRAPER PUBLISHING CO., Publishers,
88 Broad St., Room 522, Boston, Mass.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

NOVEMBER, 1906.

This number begins the sixth year of publication of this magazine. We take this occasion to thank our readers for the cordial support that they have given it, and to say that plans are now being perfected for increasing both the size and scope of the contents of future numbers. The many complimentary letters which we are constantly receiving is most encouraging evidence that the magazine is of practical value to those reading it. Repeated instances have come to our attention where articles in this magazine have been utilized for direct monetary benefit. Two of these instances are given as illustrations: A carpenter in a near-by city made, during his leisure time, several pieces of furniture described in the magazine. A visitor, chancing to see them, was so much pleased with their appearance that he purchased them at a price which gave the maker a substantial return for the time spent in making them. The success of these articles being so satisfactory, he continued making furniture, finding a ready sale for the same, and is now giving a very considerable portion of his time to this work, finding it more productive than his regular trade. He has made, in the interim, a foot power saw table and band saw, which greatly facilitates the work. Another carpenter, living in a sea-coast town, has made quite a number of skiffs which he sells readily to yachtsmen at good prices. It is quite probable that many other readers who have leisure time and a fair degree of skill in woodworking could develop a similar line of business.

We would again call attention to the necessity of giving both the old and the new address whenever change in the mailing directions is sent us. We have also received a number of letters recently, without signatures. Should any one have failed to have received a reply to their inquiry or letter, the reason for this may be as above.

The time is approaching when we begin to think of Christmas and what we will do in the way of Christmas gifts. For that reason quite a number of articles are described in this number which are particularly suitable for that purpose, all of which may be easily made by one possessing ordinary skill with tools. The back numbers of the magazine also contain many articles describing things equally suitable. The advertising columns of the September issue give a list of articles on furniture, and in this number is a list of games, etc. A gift which is the product of the giver's skill carries with it associations not found in things purchased, and the enhanced sentiment adds much to the pleasure of both the giver and the receiver.

The auxilliary yawl, a description of which begins in this number, is a type of boat which has become very popular during the last few years, and we are confident that readers interested in boat building will welcome these articles. The boat is large enough to be comfortable for cruising along the shore, and yet not too large to be beyond the capacity of the amateur builder. We shall in an early number give the lines for a boat 30 feet long, so that those who prefer a larger boat can build the same from the description given, which will be very complete regarding the details of construction.

The cordial reception given the recent articles on boat-building has been very gratifying, and we shall hereafter, in addition to the descriptions published, give the lines of various types of boats which would be of interest to amateur builders.

Owing to the large demand for back numbers containing the descriptions of small boats, we have published a reprint of the following boats:—20 foot speed launch, sailing dory, rowing skiff, 9 foot skiff tender, sectional skiff and canvas canoe, which together with "Boat Sailing for Amateurs" are issued in one book, which will be sent postpaid for 25 cents.

A barrel of crude petroleum is 42 gallons, or 5.9146 cubic feet; a barrel of refined petroleum 50 gallons, or 6.684 cubic feet.

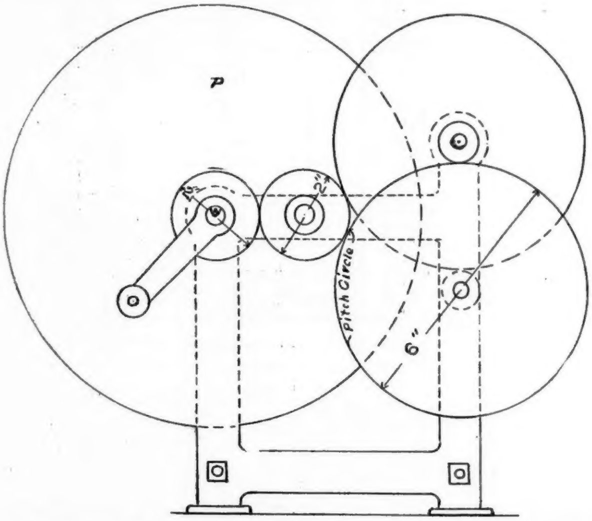
INDUCTION COIL WINDING MACHINE.

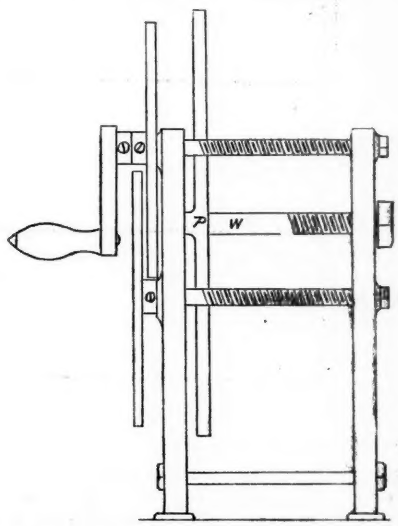
FREDERICK A. DRAPER.

A method of coil winding described in the October issue of this magazine required the use of a screw-cutting lathe with gears set as for cutting 60 threads to the inch. As many readers who might like to make coils after this method may not possess a screw-cutting lathe, and as a simple yet adequate winding machine can be made at small expense, such a machine is here described. It also possesses one decided advantage over a lathe, and that is the ability to stop winding, instantly at any time. While a lathe is very apt to run over or the wire to twist or break if too sudden a stop is made.

The way to use such a machine is to mount the bobbin on the winding shaft, pass the bare wire between the two screws and fasten the end to the bobbin, allowing sufficient free wire for subsequent connections. The wire is then held by the fingers so that, as the winding proceeds, the wire will be in the turns of the screw and be guided across the bobbin. To reverse the direction it is simply necessary to use the other screw, the top side of the lower screw and the under side of the upper screw turning in opposite directions.

The construction of the winder is shown in the accompanying drawings. The frames are of cast iron,





On this machine secondary windings may be wound up to 10 inches in diameter; a size quite as large as any reader is likely to attempt. In Fig. 2 will be noted two screws with 20 threads to the inch. On the left ends of these screws are gears of 6 in. pitch diameter, meshing with an intermediate gear 2 in. diameter, which in turn meshes with a 2 in. gear on the winding shaft.

It will be noted that the ratio of the gear on the winding shaft to those on the screws is 1 to 3; three turns of the former are required, therefore, to get one of the latter. As the screws are cut twenty threads to the inch, this enables wire to be wound on the bobbin turning on the winding shaft with 60 turns per inch; the number specified in the article on coil winding referred to. By varying the ratio of the gear any number of turns of wire can be provided for. The intermediate gear may be of any convenient diameter.

that on the right side having no winding shaft bearing or supporting arms. A ½ in. hole is drilled for the winding shaft, *W*. The shaft is fitted with a face plate *P* of the size required for the coils to be wound, and a turning crank fitted to the left end outside the gear. The right end is threaded to receive a nut for tightening up another faceplate or bobbin end. A shaft 6 in. long will be ample for all ordinary needs, 3¼ in. of this length being to the right of the inner face plate.

The screw shafts are about 6¼ in. long; 2 in. at the left end being ⅜ in. in diameter, without threads, then 3⅞ in. threaded, 20 threads per inch, and 1 in. on the right end turned down to ¼ in. The gears fitted to the screws should have hubs and set screws, for fastening to the screws. The intermediate gear runs on a stud. In drilling the holes in the frame for the bearings of the shafts, care must be used in spacing them so that the gears wi run without binding or too

much play. The easiest way to be sure of this is to have the gears made and at hand before drilling holes for the stud and screws.

At the bottom of the frame are two tie rods with nuts at the ends, these being necessary to secure a rigid frame. The gears have such light duty that they need not be over ¼ in. thick, except the intermediate gear which must be thick enough to drive both screw gears or about 5-16 or ⅜ in. thick. The threads on the screw shafts may be cut with a common die, any broken threads being smoothed off with a V needle file, so that the wire will not catch and break.

A B C COMBINATION MONEY BOX.

This is a box which is both useful, amusing and educational. With it any word of three letters can be formed, and it can be set to open by forming one particular word.

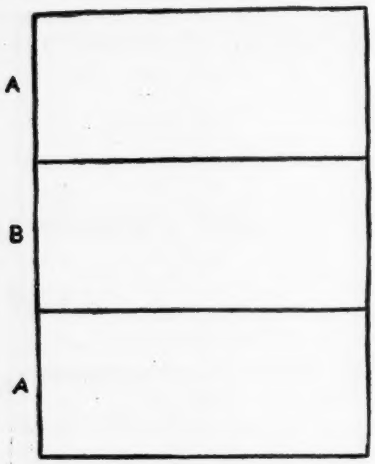


Fig. 1.

The box may be turned from good sound wood, and is composed of three parts, a cylinder with raised band in center, and two lids. These are shown in Fig. 1, *A A* being the two lids, and *B* the band of cylinder. Fig. 2 is a sectional drawing showing the thickness of cylinder and lids and also illustrating the interior mechanism. *C* is a rod screwed firmly into center of top lid. D is a flat disc with bent prongs under it, as shown, and having two slots at its outer circumference, through which *F F* can pass. *F F* and the slots are shown by Fig. 4, which represents *D*. *E* is another disc with a washer under it of sufficient thickness to keep it in position so that the prongs of *D*, after passing through two slots in *E*, may work freely under it. *E*, together with the washer, is screwed down to center of lower lid. The lid and *E* with the slots, is shown by Fig. 3.

A groove is made round the cylinder at *G*, and a hole is bored at each end of the lower lid at *G G*, and into each hole, while the lid is on the cylinder, a peg is inserted, so that the lid may be revolved, but will not come off. It will be seen upon studying this mechanism, that it is only when both lids are in certain position relative to the cylinder, that the top lid can be taken off, as *D* being turned by the top lid, must be

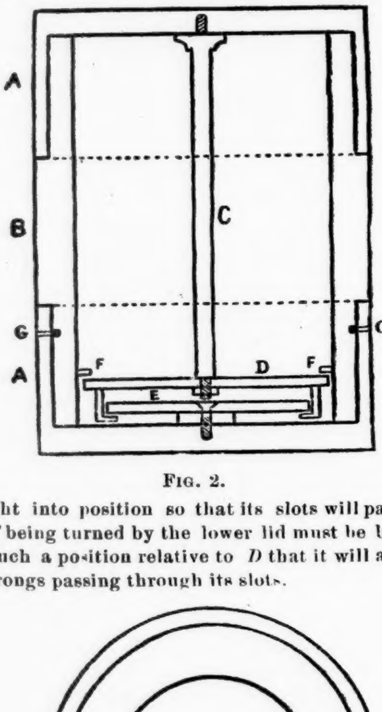


Fig. 2.

brought into position so that its slots will pass *F F*, and *F* being turned by the lower lid must be brought into such a position relative to *D* that it will allow of the prongs passing through its slots.

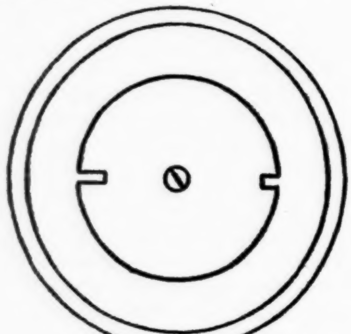


Fig. 3.

Fig. 5 shows a set of three alphabets on the outside of the box—one on each lid, and one off the band of the cylinder. It will be seen that the letters in the il-

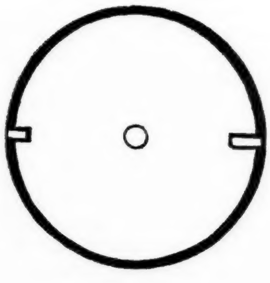


FIG. 4.

ustration spell CAT. Now if the discs D and E have been set so that their slots will pass F F and the prongs through them when this word is put together, the top lid can be removed. A slot to admit the coin can be made in the top lid. Any other word can be used.—"Hobbies," London.

FIG. 5.

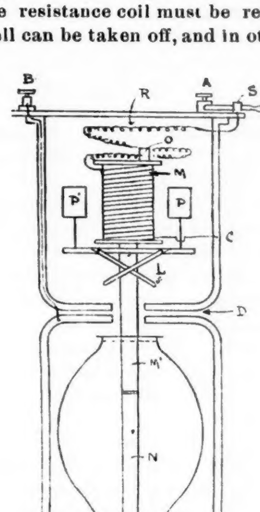
PRACTICAL HINTS ABOUT ARC LIGHTS.

To the practical man, the history and theory of the arc lamp are not a necessity, but the knowledge of its mechanism and mode of operation are absolutely essential. So long as the lamp needs only trimming and cleaning, the average attendant will ignore its mechanism, and in all probability no attempt will be made to comprehend its operation. The moment the lamp fails to light, strenuous efforts will be put forth to try to discover the reason for such failure.

When the lamp fails to light, assuming that it has been properly trimmed, one or all of the following causes may be looked for: 1st, the resistance coil may be burnt out; 2nd, the magnet coils may be burnt out; 3d, the framework may be grounded, thereby preventing sufficient current to flow through the carbons to produce an arc; 4th, broken or grounded connections; 5th, when the movable carbon is continually in motion, thus preventing a steady light; 6th, when the clutch fails to lift the carbon. These six difficulties will be the principal ones met with in practice.

The mechanism of an arc lamp is shown in Fig. 1, and while the shape and construction may vary with different manufacturers, the underlying principles involved in its operation will be found practically the same. Some lamps have their resistance coils wound on separate spools, others have no spools, while still others have their resistance coils wound on one large spool. Again, some lamps are fitted with two magnet coils, while other lamps are only fitted with one. The mechanism of the carbon clutch also varies in different lamps, as do the dash pots employed to resist or counteract the solenoid magnet.

The shell or outer casing varies in shape, the methods for taking off and putting on are different; in some arc lamps the resistance coil must be removed before the outer shell can be taken off, and in other cases the



shell can be taken off without disturbing the lamp mechanism. Then, the method employed to convey the current to the movable carbon is not always the same; some manufacturers solder a flexible wire to the carbon holder of the movable carbon, so as to insure

this carbon with a positive supply of current, while others depend upon the frictional contact of the carbon holder to insure current supply to the upper or movable carbon.

Referring to Fig. 1, the mains carrying the current are connected to the binding posts *A* and *B*. The current flowing through *A* passes through the switch *S* and resistance coils *R*, thence through the magnet *L*. The current is grounded on the upper frame of the lamp, as shown at *C*. The wire *B* is insulated from the upper frame work of the lamp, and the wire is grounded on the lower frame work. Thus it will be seen that the frame of the lamp is divided into two parts and insulated from each other at *D*. It follows, therefore, that when the carbons are inserted at *M'* and *N*, a passage for the current is provided and if we procure a mechanism to move the carbon *M'* upwards or the carbon *N* downwards, an arc will form between the carbons and light will result.

If the carbons are moved only a slight distance apart, a poor arc will be obtained, accompanied with little light; hence, to obtain a more powerful light the length of the arc must be increased, the amount of which will be dependent upon two factors, namely, the amount of the resistance cut in the circuit at *R* and the lifting power of the magnet *M*. If the magnet *M* is in good order and the arc still remains short, too much resistance is cut into the circuit, which must be lessened by moving the clip at *O*, thereby reducing the length of the resistance wire. The length of the arc should now increase, and consequently a more powerful light should be obtained. If the clip D is moved so as to increase the resistance *R*, the arc will decrease.

Sometimes, no matter how much resistance is cut out, the arc will not increase in length. In this case it will be found that the magnet *M* is either wholly or partially burnt out, in which case the magnet must be replaced with a good one. Before discarding the injured magnet, however, it will be a good plan to test it, by allowing the current to flow around it and then by placing a screwdriver or some iron or steel tool against the magnet, its lifting power can be determined. Should the magnet be found strong and therefore not burnt out, then the trouble will be either in the lifting mechanism shown at *L* or in the dash-pots shown at *P* and *P*.

The object of the dash-pots is to resist the lifting of the carbon too suddenly. Should the carbon be lifted with a "jerk," there is a possibility of drawing the carbon out of the field of the arc, thus breaking the arc and no light results. The correct working of the dash pot is an important factor of arc lighting, and to determine if it does operate correctly, it should be seen that it requires considerable force to press the plunger into the pot quickly. From this it is learned that a blow or push will be resisted by the partial compression of the atmosphere, hence the sudden action of the magnet is controlled and the carbon is maintained within the field of the arc and light is formed the moment the contact of the carbons is broken.

Whenever a lamp becomes grounded, the movable carbon sometimes traverses its entire stroke without forming light. Of course, this ground must be removed and the simplest way to do it is to remove the outer shell or casing, then trip the lamp and throw on the current, when the ground should make its appearance and can be easily removed.

When continuous arcing occurs it will be found that the plungers of the dash pots are worn sufficiently to permit of a rapid lifting and dropping of the carbon and in such a case as this, satisfactory lighting is impossible. Sometimes the lamp will not burn satisfactorily, although the lamp mechanism and trimming are all right. This is often due to the arc traversing the perimeters of the carbons instead of being central. Impurities in the carbons will cause this, and in order to overcome this difficulty, hollow and cored carbons are employed.

In the latter case, the center of the carbons is filled with a soft carbon which is easily vaporized, thus lessening the tendency of the arc to traverse the circumference of the carbons, thereby preventing avoidable shadows. With enclosed arcs, when opalescent globes are employed, the shadows will not be noticeable to any great extent, as this form of globe diffuses the light more equally than clear globes.

It is important to have the upper carbon the hottest, as this will deflect the light downwards. When an arc lamp is first connected to the mains, it may not be wired so that the upper carbon will be the positive carbon. If, however, the current be thrown on and lamp allowed to burn for a few minutes and then cut off the current, it can easily be seen which carbon is the hottest, and should the lower carbon be the hottest, the lead wires to the lamp must be reversed.

It is sometimes necessary to know what voltage is maintained across the arc. For this purpose, a portable voltmeter can be used and connected to the upper and lower carbons. The arc being formed, the voltmeter will register the necessary voltage to maintain the arc and by connecting the voltmeter to each arc in the circuit and by shifting the resistance in each lamp, an approximate equality of the voltage can be maintained throughout the various lamps and each lamp will properly do its share of the lighting.

The length of time a carbon will last depends upon the amount of air which is admitted to it; hence, to prolong the life of the carbon, the inner globe is often made as air-tight as possible. The inner and outer globes should be kept clean, as this will materially assist in the proper diffusion of the light.—"Practical Engineer."

No place on earth is immune from earthquake. A short time previous to the Charleston earthquake, the city of New York was visited by a slight but very noticeable shock.

PHOTOGRAPHY.

USE OF DEVELOPING PAPERS.

C. H. CLAUDY.

II. Developers and How to Use Them.

Developing papers are developed with any good developer, all those which act upon plates to produce negatives giving some kind of results on the paper. But some are much better than others for this purpose and some unsuitable, among these being pyro. Hence it is advisable to have a special developer for that purpose alone. Now I do not pretend to be able to say which of the various organic developers is the best for paper use. But I do not think there is any question that Metol-Hydrokinon is the most used for that purpose. This developer is made up in a dozen different formulas, according to the particular wishes of the maker and the kind of prints wanted. For instance, if hard prints are wanted, as in line work or from very weak negatives, the metol may be reduced to a trace, or left out altogether—and for very soft prints the proportion of metol may be equal to that of the hydrokinon. My own formula, which is an adaptation of several, is as follows:

50 oz. water, temperature 50 F.
½ oz. metol.
1 oz. hydrokinon.
7½ oz. sulphite soda, crystals.
12½ oz. carbonite soda crystals.
1-16 oz. bromide potassium.

These chemicals are fully dissolved, in the order named, in hot water, with care that each chemical be fully dissolved before the next is added to the water. Particular care should be taken to dissolve the metol first and the hydrokinon second, and not reversed, as if this particular is not attended to the hydrokinon will crystalize out after cooling. Immediately all the chemicals are dissolved, the solution should be bottled, filling to the neck and well corking them. When they have cooled, the solution will have shrunk a little, and the bottle should then be filled full again. The object of filling them to the brim is to insure the exclusion of air, and if this is carefully done the stock solution will keep for a long time—I might almost say indefinitely. I have kept it nine months in this way and found it clear when it was finally used. It is obvious that small bottles should be chosen if the developer is not used up rapidly, so that when part of a bottle is used, there is not much left for air contamination. Four ounce bottles are excellent.

To use this developer take one ounce of the stock solution to seven ounces of water for the hard papers and two ounces of stock to six ounces of water for the soft papers. More stock and less water means softer prints. Less stock and more water means harder prints. This is exactly the reverse from the effect on a plate. Consequently the softest print can be obtained by using undiluted stock solution.

The fixing bath must be acid, and must contain alum. Whether the acid be organic or not, or the alum plain or chrome does not make so much difference. I have used both with good success, but prefer the plain acetic acid bath, the formula for which follows:

Water 64 ounces.
Hypo 16 ounces.

Dissolve thoroughly and then add solution made up as follows:

Water, 10 ounces.
Sodium sulphite crystals, ½ ounce.
Acetic acid 12 per cent. (commercial) 3 ounces.
Powdered alum ½ ounce.

If the acid is not commercial the proportion must be calculated from its per cent, which the druggist can probably tell you if it is not marked. I usually buy 36 per cent acid and of course use one ounce in place of the three which would be used were the acid 12 per cent.

This solution keeps perfectly and can be used until it turns milky, when it should be discarded for fresh.

An important point, particularly in hot weather work is the arrangement of the trays. They should be in the following order, side by side. Developer, clear water, hypo, and preferably from left to right. If the print is to be wetted down before development, have an extra tray of clear water to the left of the development tray. Another important point is a stirring rod of glass, bent at an angle in the middle and mounted in a wooden handle. The handle is a sure marker of which is the hand end of the rod, and the bend makes it easy to stir up the print in the hypo.

There are several methods of getting the developer on the paper. With small work and much developing to do, the easiest is to slip the print into the tray of developer, edge first, being sure that it goes under the surface swiftly and without a break in the movement. With larger work and not much to do, it may be wise to empty the developer into a graduate between each development, lay the exposed sheet in the tray and pour the developer on with the same movement one

uses in covering a plate with the solution. But prints as large as 10 x 12 may be slipped into the pan of developer with a little care and practice. To do this successfully, take the tray in the left hand by one edge and tilt until the developer runs toward the left hand. Hold the paper by the right edge in the right hand and the hand under it so it lies flat. Let the left edge of the paper drop into the developer at the same time letting the tray become horizontal, while the right hand lets go the paper. The developer will cover the paper evenly in one sweep. For an 8 x 10 print not less than 8 ounces of solution should be used with this method.

With larger sheets of paper it may be easier to thoroughly wet the paper first and then pour the developer on. Nothing but disaster can be expected in attempting to slip a wet limp sheet into the tray, so if the paper is wet down always pour on the developer from a graduate. The object of the wetting is to cause the developer to run on without stopping. Sometimes the developer makes the image come up streaked, a phenomenon due to impure sulphite of soda; the wetting down of the print will prevent the trouble. With small work, however, wetting down is an evil, as it is unnecessary and quickly dilutes the developer.

No definite time can be set for completion of development. As in a plate the development should be for some particular part, usually the high lights. If the shadows are too black by the time the high lights have their detail it is a sign of under, not over, exposure. Prints usually develop in from ten seconds to one minute, depending on the temperature of the developer, the kind of paper and the amount of exposure. The temperature should not be above 65° F. in summer or 70° F. in winter, and inattention to this point will result in either flat or muddy prints, if the solution is too warm or mealy, over constrasty or weak prints if the developer is too cold.

A few seconds before development is completed, get hold of one corner of the print. When the print has gone far enough, pull it quickly from the developer and souse immediately into the clear water bath—run it through quickly and then dump it into the hypo. Immediately pick up the rod and stir the print up well so that the hypo reaches all parts of the surface. Prints had better be thrown into the hypo face up, inasmuch as air bubbles can be better destroyed with the rod, but care should be taken that the rod is not used too roughly on the surface of the print, otherwise, particularly in warm weather, the emulsion may tear. The fixing bath is better cold than warm—and a fresh bath is therefore indicated in warm weather—a fresh bath being very cold on account of the action of the hypo and water together, an action, by the way, not at all understood any more than that of sulphuric acid and water, which generates heat without any apparent chemical change.

Prints should be fixed fifteen minutes and turned over several times in that period to insure thorough access of the bath to all parts of the film. But longer fixing does no harm. I have left prints in the bath two hours, while at work on more prints, and have seen no ill results. The Eastman Co. put out a non-abrasion developer which contains iodide of potash, resulting in the prints being turned canary yellow in the development. When this color disappears in the bath fixation is supposed to be complete. I have seen it go in thirty seconds in a clean bath yet they advise the time of fixing given above. At any rate, thorough fixing does no harm and is no more trouble than quick fixing.

After fixation, prints should be washed in running water from half an hour in summer to two hours in winter, and the prints should be kept moving. A pile of motionless prints in the bottom of a tray into which and from which water is running, are not being washed. If the force of the water cannot be so graduated as to keep the prints in motion, stir them up every few minutes with the hand. When washed they should be swabbed off with a tuft of cotton to remove dirt and sediment and then laid out to dry. Face down on cheese cloth, after they are surface dry, is a good method. Personally, I dry on newspapers or blotters face up because I am usually in a hurry and find no difficulty in straightening out my prints by drawing them over the sharp edge of a desk or table.

These are one or two points connected with development it may be well to notice. In cool weather the print may be lifted some time before development is completed, and the finishing of the process watched closely, of course, with the print shaded by the body or screen from any direct light. In warm weather the print with developer on it should be exposed to air as little as possible. Most of the brownish stains in the whites which are the bane of the process, are caused by oxidized developer, either in the hand or in the fixing bath, the print not having been moved about sufficiently.

Hand development of prints can be accomplished by using a couple of brushes, and plenty of glycerine, as in the platinum process, but the brush work must not continue more than a couple of minutes at the outside in cool weather, otherwise the developer will oxidize and a stain result. The print, of course, in that process, should be supported on a piece of glass.

There is a great deal of latitude in the exposure which can be given this class of paper, yet some one exposure is always the best. As a general rule, Velox and papers of its class are under exposed. The blacks are too black and the whites are too white. A more prolonged exposure with the same time of development is wanted. The first time you get a fairly good print, try another one from the same negative with double the time and note that both are presentable but that the contrast of one is greater than the other.

Regarding the surface, the dead smooth and the glossy are a little harder to work than the roughs, as

development may leave marks if the solution is not entirely pure. On the glossy paper are often found marks looking like pencil marks, caused by abrasions of the surface. They can be easily removed from the dry print by scrubbing gently with cotton slightly dampened, not wet, with alcohol. The other two remedies are, not to use this paper or to use a non-abrasion developer. If glossy paper is to be squeegeed, be sure the fixing bath is fresh and strong, otherwise the film will not be hardened sufficiently and may stick to the surface of the squeegee board.—"Photographic Times."

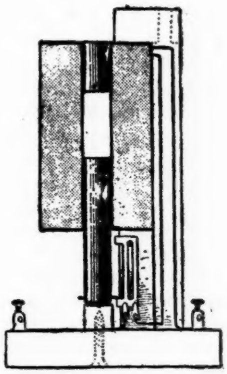
HOW TO MAKE AN ELECTRIC HAMMER.

The following instructions for constructing a hammer actuated by electricity will be found useful in making any device in which a "sucking solenoid" is required. The sizes of the parts, the gauges and proportions of the wire given, are suitable for a small hammer capable of working off a 4 volt accumulator, or off a couple of quart size bichromate batteries, connected up in series; but by increasing the size and varying the amount and gauge of the wire used to wind the solenoid, the size of the hammer can be increased and the winding altered to accomodate the E. M. F., or "voltage" of the current supplied. In order to render our instructions perfectly intelligible, we give a sectional view of the complete arrangement.

The operator will begin by procuring a piece of round soft iron, 4 in. long, ½ in. in diameter. This he will divide by sawing into two unequal lengths, one piece being 1 in. long, and the other 3 in. The ends of the pieces should be filed up smooth and level and the longer piece made very smooth by rubbing over with fine emery cloth. This latter piece we shall for the future call the "hammer." A piece of thin brass tube 9 16 in. inside diameter, 3¾ in. in length, is now selected, into which the "hammer" can slide freely, and its inside is made quite smooth and bright by polishing with a straight round stick dipped in powdered brickdust. This being done, two "heads" or flanges, 2¼ in. in diameter, are cut out of thin brass sheet, a hole about ⅝ in. diameter put through the center of each.

The exact size of these central holes must be such as to admit the aforesaid brass tube being fitted tightly in them. These two flanges are then soldered, one at each end of the tube, so as to form a light metal reed or bobbin. To insulate this and thus prevent any chance electric leakage between the wire which has to be laid on, and the brass of the bobbin itself, it will be advisable to paste one turn of fairly stout brown paper round the tube itself, and a circlet of similar paper on the inner face of the heads.

The neatest way of effecting this latter portion is to strike out with the compasses the two circles on brown paper, cut these out, as also the ⅝ in. central apertures, and then give a radial snip with the scissors from circumference towards the center. The central tube can be pushed in this radial slit, and the paper circlet be then pasted smoothly down on the face of the flange. The operator will now require about 2 pounds No. 17 d. c. c. wire, with which he will wind this bobbin. Beginning at one end close against the flange, he will tie one end down with a bit of silk twist, leaving about 6 in. free for future attachment to a terminal, etc., and then proceed to wind the wire closely and evenly round, until he reaches the opposite flange. This will take about 56 turns of wire.



He then winds back again, always coiling in the same direction, until he returns to the first flange, and so on until he has laid on 19 layers and ends at the starting flange. Here he ties down firmly as before, the bight of wire to prevent uncoiling, cutting off any excess beyond 6 in. which will be required for connection. The bobbin having been thus wound and converted into a "solenoid" is to be fitted at its upper extremity, *i. e*, that at which the wire ends are situated, with the shorter piece of iron.

For this purpose a sufficient number of turns of brown paper are glued and rolled tightly round the 1 in. length of round iron until it makes a tight fit in the upper end of the brass tube. It is then painted over with a coat of thick shellac varnish, and forced into the tube until the surface of the iron rod is level with the ends of the tube. In order to give a finished appearance to the solenoid, and to prevent the wire from getting soiled or accidentally uncoiling, it will be well to give the last layer of wire a coat or two of varnish, which may be made by mixing a half teaspoonful of Brunswick green or Chinese red powder with sufficient "white hard" varnish to produce a rather thin paint.

This coat of varnish should be allowed to dry in a warm room for about 24 hours. While it is drying we proceed to make the stand for supporting the solenoid, the contact breaker and the anvil. For the base of the stand a piece of any hard, well seasoned wood, 4 x 4 x ¾ in. thick, when planed up, will serve admirably. In the center of this, to serve as an anvil, should be placed a cylindrical back of zinc, easily cast from the melted metal in a plaster of Paris mould, that should be held in place by a screw passing through the base from below. This anvil should be ⅝ in. in diameter and ¾ in. in height.

To support the solenoid centrally over the anvil at a height of 1½ in. above it, we prepare a wooden upright 7 in. long by ¾ in. square section. Having procured a similar piece of hard wood, 1½ in. long, we put through it at ½ in. from one end, a round ½ in. hole. We then round the upper end of our upright for a length of ¾ in. into the shape of a peg ½ in. in diameter, leaving a truly square shoulder below it. We then glue the peg of the upright into the hole just made, so that the arm stands at right angles to the upright. With a mortising chisel we cut a ¾ in. square hole in our base board at such a point along one side thereof that if the solenoid be held firmly against the upright, the center of the solenoid shall coincide with the center of the anvil beneath. The lower extremity of our upright is now served with a little good hot glue and inserted in the hole just made, care being taken to have it quite firm and perpendicular.

While the glue is drying we cut out of rather thin sheet brass a flat ring or "washer" ½ in. inside diameter, ¾ in. outside. This we push on the extremity of our hammer, (the 3 in. length of soft iron) for a depth of about 1 16 in., and solder it firmly thereto from the outside. We now slip the "hammer", washer end outwards, and hold the solenoid centrally over the anvil, resting on one side against the cross arm of the said upright. While being held in this position the exact distance, about 2¼ in., between the face of the base board and that of the lower flange of the solenoid is measured, and a nicely squared piece of wood prepared of this length, ¾ in. square, that shall, when glued against the inside of the first upright, wedge the solenoid tightly in place, and at the same time not impede the free motion of the hammer and its washer up and down the solenoid tube.

If two thin brass strips, about ½ in wide, be bound, one above and one below, round the solenoid, and then fastened to the upright by little brass screws, not only will the rigidity of this latter be greatly exalted, but the appearance of the whole will be much improved. The woodwork may now receive a coat of black cycle enamel. All that remains to be done is to make and fix the sliding switch or "contact breaker," and couple the wires up to this latter and the terminals. To make the contact breaker we procure a piece of sheet brass 1 16 in. thick, about 1¾ in. long, ½ in. wide. With a fine file we remove the central portion until we have reduced the brass to the shape of], the inner edge of the gap in the center being made absolutely straight, 1 7-16 in. wide by ⅝ in. deep. The lower arm must be left ½ in. wide, the upper arm ⅛ in. wide.

A similar strip of brass, ⅛ in. wide, 1 7-16 in. long, is now inserted between the two arms of the gap, and soldered to them at such a distance from the back as to produce a slot that will admit of the free passage of screws 1 16 in. diameter in the shank. It is needless to remark that the edge of this piece must be perfectly straight and parallel to the back. This contact breaker is now fastened loosely by means of two screws inserted in the slot on the side of the upright in such a position that when the hammer falls its washer pushes down the lower limb, and when it has risen to its full height it engages in the upper limb, thus drawing the contact breaker up.

Just below this sliding piece are arranged two light brass springs, pressing lightly toward the upright; one of these is connected to one end of the solenoid winding wire, the other being taken to a terminal on the base board for connection to battery. The other end of the solenoid wire is taken direct to a second terminal on the base board, and is coupled up to the other pole of battery. The action is as follows:

When the hammer is in its normal position on the anvil, its weight drives the sliding contact down, so that it completes the circuit between itself and the two springs; the current circulates round the solenoid, and the hammer is now sucked up into the tube. On reaching nearly to the top of its stroke the washer on the hammer catches in the upper arm of the sliding contact, thus raising it and breaking contact below. The hammer immediately falls, and in so doing its washer catches in the lower arm, driving down the slide and re-establishing the contact.—"Hobbies."

A good use for the phonograph is its employment for preserving records of rapidly decaying dialects of the Isle of Man and Guernsey. In the former island the dialect language is one of the Gaelic group, and so rapidly is it disappearing, that it is anticipated that it will become extinct during the present generation. The Manx Language Society is despatching phonographs to remote parts of the island, the aged inhabitants of which still retain a pure accent, and the numerous records thereby obtained are to be preserved. In Guernsey the dialect is the old Norman French, and in its main features is exactly the same as that used by the cultured class in England in the early centuries. In this instance, it is said, the phonograph is to be utilized for the collection of the dialect poems, folk songs and folk lore of the island.

To clean smoky chimneys, dilute a teaspoonful of sulphuric acid (oil of vitriol) with five or six times its bulk of water. Dip into the solution a piece of flannel tied to a stick and draw the flannel through the chimney, then rinse in water and wipe dry.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

VI. Jump Spark Ignition.

The jump spark ignition is very simple in appearance, the only engine attachment being the commutator, or device for making and breaking the primary circuit whenever a spark is desired; this does away with a considerable amount of gear and simplifies the engines. The engines represented in Figs. 11 and 18 are of this type.

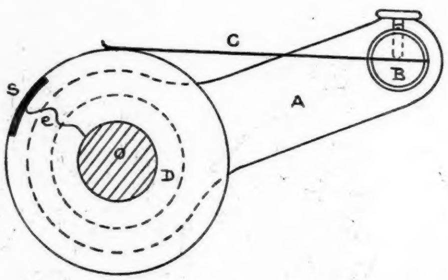


FIG. 31.

Fig. 31 represents the simplest type of make and break device. This particular device is usually located just behind the flywheel. *O* is the engine shaft: *D* is a disc of fiber or other insulating material, which is

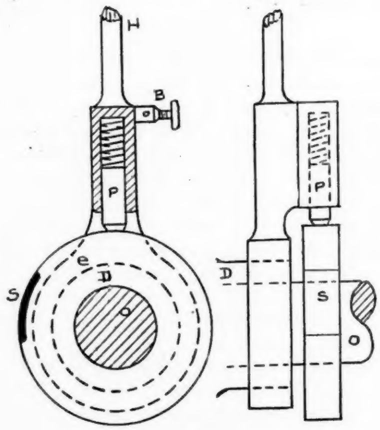


FIG. 32.

fastened to the shaft and revolves with it. This disc, *D*, has on its circumference a small sector *S* of brass or other conducting material, which is in electrical connection with the shaft by the wire or clip *e*. The frame *A* encircles and is held by the end of the engine bed, but may be revolved around it. The outer end of the arm carries a binding screw *B*, to which is attached the edge of the disc *D*. One terminal is fastened to *B* and the other to the engine. As will be seen, when the spring *c* rests upon the fiber, there is no circuit, but when the segment *s* passes under it the circuit is completed through the engine shaft and body of the engine. By turning the arm *A* around the shaft the relative time of sparking may be changed. The engine shown in Fig. 11 has a commutator, or timer, of this kind; the handle for regulating it may be seen just behind the flywheel.

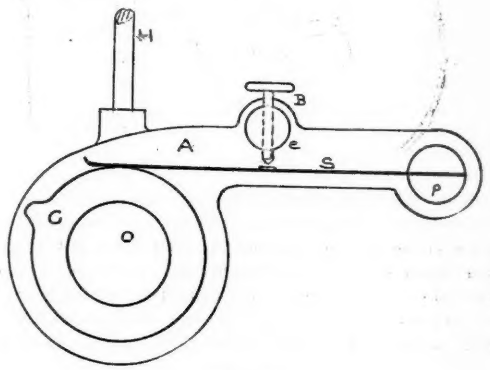


FIG. 33.

Fig. 32 shows two views of a similar form of timer; in this case the plunger *P* makes the contact, being pressed out by the coiled spring *s*. *B* is the binding post for fastening the wire from the batteries. A handle fastened at *H* is provided for changing the time of ignition.

Another form of timer is shown by Fig. 33; the shaft is shown by *O* as before, the cam *C* is fixed on the shaft and turns with it. this cam has a projection or "nub" on its face, the casting *A* encircles the hub of the bearing and has the arm *A*, at the end of which is the post *p*, supporting the contact spring *s*, which rests normally upon the round face of the cam *C*. At *B* is a binding post having the adjustable contact screw *e*; this post *B* is insulated from the frame *A* and the contact screw *e* is adjusted to leave a slight space between it and the contact spring *s*. The lead wire is attached to *B*, and in the position shown no current will pass. At the time of ignition, however, the "nub" on the cam *C* will pass under the spring *s* and force it up into contact with the point of the screw *e* and thus

complete the electrical circuit through the metal of the engine. *H* is a handle for regulating the time of sparking by revolving the whole around the shaft, thus causing the cam *c* to strike the spring earlier or later.

The timers thus described are for single cylinder engines, but may be adapted to two cylinders by duplicating the mechanism in a diametrically opposite position. Timers of this description would hardly be used for more than two cylinders; they are also best suited to two cycle engines, as they give a contact for each revolution; this class of timer is, in fact, most commonly fitted on two cycle engines of medium and low price.

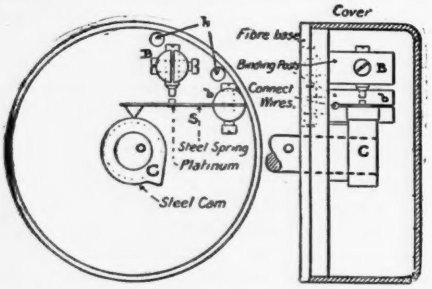


Fig. 34.

A more pretentious timer is represented by Fig. 34. It is entirely separate from the mechanism of the engine and is run from a separate shaft, such as the half time shaft of the four cycle engine, or an independent shaft driven by gears from the main shaft of a two cycle engine. It is rather similar to that described in Fig. 33, the cam *C* pressing the steel spring *s* outward

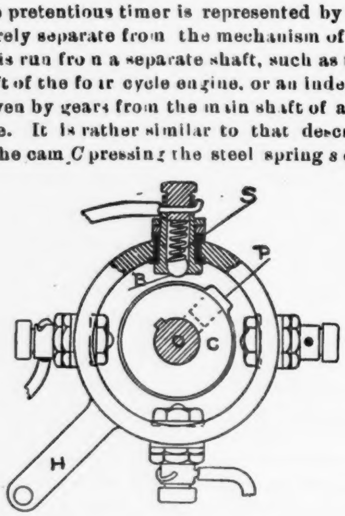


Fig. 35.

so as to bring the platinum point on the spring into contact with that on the binding post *B*, completing the circuit. In this particular timer both posts are insulated from the body of the timer, a wire to each passing through the metal of the engine. The whole is covered with a removable cover, as shown. The engine illustrated in Fig. 11 is fitted with a timer of this kind located on the rear end of the valve shaft. A little consideration will show that the timer of a four cycle engine should be governed by the valve shaft in order to give the proper timing, since the four cycle engine gives an explosion for each two revolutions; the timer must be so arranged as to give a spark in the same interval.

Fig. 35 represents a timer for a four cylinder engine; it is similar in action to that shown in Fig. 31, the steel balls *B* are pressed out by the coil spring *s*; the cam *C* having the projection *P* is revolved by the shaft, the wires are attached, as shown. At the proper time the projection *P* rubs past the ball *B*, thus completing the circuit. The ball holders must, of course, be insulated from each other and the body of

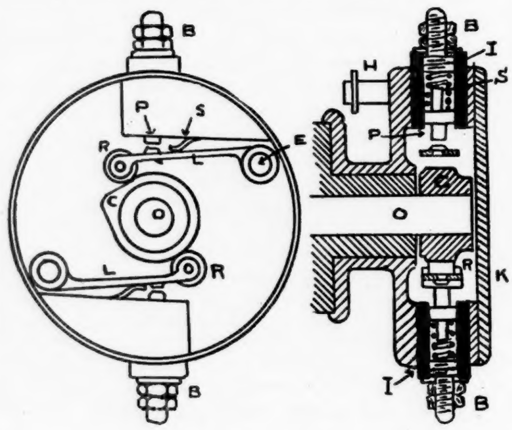


Fig. 36.

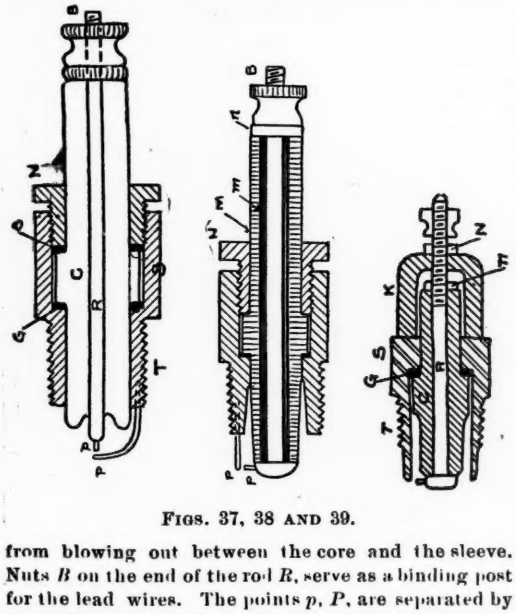
the timer; it is indeed common to make the entire body of fiber or hard rubber. In this form the timer shaft and body of the engine form a part of the circuit. There must, of course, be as many binding posts as there are cylinders. In order to change the time of ignition the entire case is turned slightly by an attachment to the lever *H*. The case is covered by a removable cap protecting it from dust and moisture.

When a timer of this type is fitted to a two cycle engine it is very convenient to place it on the end of a vertical shaft standing in front of the cylinders and just behind the flywheel, and driven by bevel gears from the engine shaft.

Fig. 36 shows two views of another type of timer on the same principle as that of Fig. 33. The binding posts *B* are insulated from the metal of the body by the rubber sleeve *I*, the contact point is forced out by the coil spring *s*, but is in electrical contact with *B*. The lever *L*, pivoted at *e*, carries in its outer end the roller *R*, the flat spring *s* presses the roller in and maintains it in contact with the cam *C*. The projection on the cam *C* passes under the roller *R* and raises the lever *L*, bringing it into contact with the point *P*, and completing the circuit through the timer shaft

and the metal of engine. The whole is covered by the cap *k*.

A very common form of spark plug is shown in Fig. 37; it consists of an inner spindle or rod *R* and an outer sleeve *s*, with an insulating core *C* of porcelain or mica. At the end of the rod *R* is a spindle point *p*, and a similar one *P* projects from the outer shell *s*. At *T* is a thread by which the plug is attached to the engine, a threaded hole passing through the water jacket and allows the sparking points to project inside the cylinder. The core is passed through the shell *s* and is held in place by the internal nut *N*, two rings of asbestos packing, *G G*, are inserted to prevent the gases



FIGS. 37, 38 AND 39.

from blowing out between the core and the sleeve. Nuts *B* on the end of the rod *R*, serve as a binding post for the lead wires. The points *p*, *P*, are separated by a small amount 1 32 to 1-16 in. When the plug is screwed into the cylinder there is no electrical connection between them; if one wire from the coil is grounded on the engine and the other is fastened to *B* the current will jump across the gap between the points when the contact is made.

Fig. 38 shows a type of mica insulated plug. The insulating core consists of a layer of mica wound around the rod; outside of this layer of mica is a series of mica discs slipped on over it; the head on the end of the rod holds the washers against slipping off and allows them to be pressed tightly together by the nut *n*. The remainder of the plug is similar to the one above.

In the form shown in Fig. 39 there are two porcelain insulators, the inner one *C* as before, and the outer one *K*; they are held in place by the nuts *N*, *n*. The metal shell *s* is prolonged and the spark takes place between a point on the end of the rod and the edge of the shell *s*.

It is necessary that the insulation between the two portions of the plug be very complete, as the secondary current used with this form of ignition is of very high voltage and will easily penetrate any of the ordinary forms of insulation. Porcelain, mica, or some kinds of homogeneous stone are the only satisfactory insulating materials for this use. The plug is one of the most sensitive portions of the engine, as well as one of the most important; it must, therefore, be well taken care of and kept in good condition.

The details of coils and wiring are to be considered in the following chapter.

GERMAN FARMERS DISTIL ALCOHOL.

Representative E. J. Hill, of Connecticut, who assisted the Commissioner of Internal Revenue to formulate the rules under which the free alcohol law went into effect on October, spent most of the summer in Europe with Commissioner Yerkes in investigations on this subject. Mr. Hill states that Germany was the country in which the most progress was found to have been made in the direction of applying denatured alcohol for the development of industrial purposes. There are 70.000 farm distilleries in Germany, many of them being very small, and Mr. Hill was asked how the German Government could afford to furnish an inspector to each one of these distilleries. He replied:

"There is no difficulty in that respect. The stills have to be made in a certain way, which includes a tank that can be locked with a Government lock and sealed with a Government seal. The small farm distilleries do not operate all the year round. They operate in the winter when the farmer has leisure to do something other than straight farm work. The farmer has to give the Government thirty days notice as to the time he wants to begin to operate his still. Some time during the thirty days an inspector comes along and looks the still over to see that it is clean, etc., and then he locks and seals the tank, after which the still is ready for the farmer.

"He may go ahead and distill until the tank is full. Then he informs the person who is to buy the alcohol from him, after which he notifies the Government, and an inspector comes and removes the seal, measures the contents of the tank and collects the revenue. If the farmer wants to denature the alcohol on the spot he can do so in the presence of an inspector, when the amount of the tax will be returned to him. But generally the farmers sell through the great central selling agencies, which denature at a central point and in large quantities, and collect the rebate from the Government in considerable sums. Thus the Government agents are not required to spend any appreciable time on any one farm, and one inspector can cover a large territory. Meanwhile the central selling agency pays the farmer on the basis of beverage alcohol and rebates for all that is denatured. It is a good system and not very expensive to the Government."

HOME BOWLING GAME.

FRANK W. POWERS.

Visitors to many summer resorts and pleasure grounds during the past season may have seen a new type of bowling alley which seemed to provide much entertainment for the players. In place of the customary pins, however, were to be found swinging wooden plates which, when hit by the ball swung up and were held until again dropped in place by pulling a cord which released a catch. This arrangement dispensed with the necessity of constantly setting up pins, and permitted the game to be played much more rapidly than formerly, and so greatly increased the interest in it.

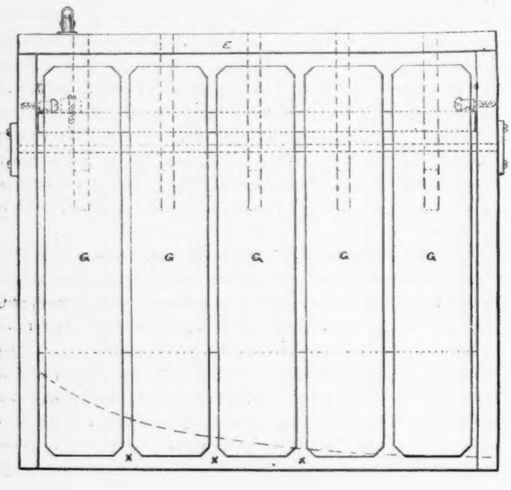


FIG. 2.

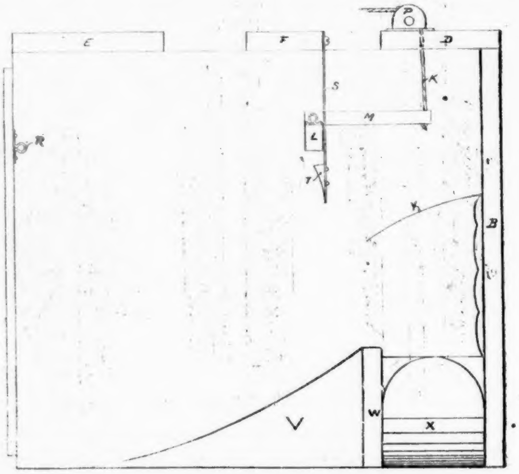


FIG. 3.

A modified form of this game is here described, which adapts it for home use and greatly reduces the noise incident to a game of this kind. The expense for materials is small, as much of the material can be taken from a small packing case made of wide boards. In addition there will be needed:

5 strips of maple or birch 15 x 3 x ⅝ in.

2 pieces ⅜ in. brass curtain rod supports.

1 small brass pulley.

5 pieces spring brass 6¾ x ½ in., and screws, sheet tin, etc.

The first work will be to cut out the pieces for the sides 19 in. long, 16 in. high and ¾ in. thick. The piece forming the right side has an opening cut in the rear, lower corner, as shown in Fig. 3 to form an exit for the balls. The back *D* is made from a piece 17 in. long, 16 in. high, and ¾ in. thick.

Across the top at the back, nail a piece, *D*, 18½ in. long, 4½ in. wide and ¾ in. thick, and across the front a similar piece *E*, 6 in. wide. Also cut out another piece, *F*, 3 in. wide, which is located about 3½ in. back of the front piece but is not fastened in place until the swinging pieces are placed. To this piece are attached the spring catches, holding the swings as shown at *S*, Fig. 3.

Having cut off the corners of the swings *G*, as shown in Fig. 2, draw lines across the back 3 in. from the top ends, and centering upon these lines, fasten the curtain rod supports, *R*, with short screws, locating them about ¼ in. from the edges of the swings. In doing this, it is best to place them upon the rod, as they must swing freely. Holes are then bored through the sides to hold the ends of the rod carrying the swings, the front sides of which should be even with the front edges of the sides of the box.

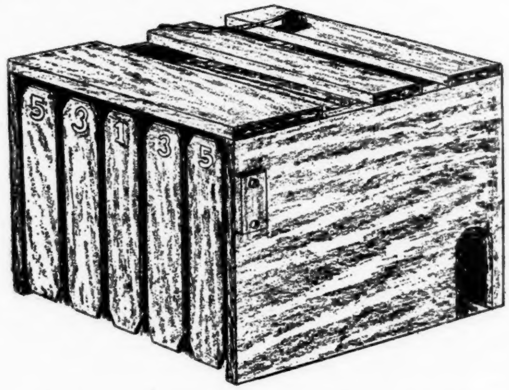
To space the swings on the rod, cut four pieces 1 7 16 in. long from the wooden part of a bundle carrier; the kind used by grocers and provision dealers for packages. The hole is about the size to slip tightly over the curtain rod. The ends of the pieces should be smoothed off with a file, and one piece is put between every two swings. The pieces at the ends of the rod are ⅝ in long, which will space the swings ⅝ in. apart.

The spring catches are next made. The spring brass straps should be sufficiently flexible so that when the swing flies up the stop *T* will be pushed back and yet return quick enough to catch the swing and hold it. On the lower end of each spring a wedge-shaped piece of brass or hard wood is attached, brass being preferable and wearing better. The upper ends

are fastened to the piece *F*, which is then fastened in place, the end swings being used to locate the correct position.

The release, *L*, is then made. It consists of a piece of hard wood 16 15-16 in. long, having a curtain rod support at each end and swinging on a rod similar to the arrangement for the swings. In addition is the lever *M*, one end of which is fastened to the piece *L* with screws, after boring a hole to allow the curtain rod to pass through it without binding. The release is located so that the under edge of *L* will be ⅜ in. above *T*, and the rear edge just touching the springs *S*.

Bore a small hole at the rear end of the piece *M* for the cord *K*, and at the proper place abo e attach the pulley *P*. A stout cord, long enough to reach to the position of the players is used, a strong pull forcing back the springs *S* and allowing any of the swings held by them to drop.



At the bottom of the box is next fastened a piece of wood, *W*, 17 in. long, 4½ in. wide and ½ in. thick. Two pieces of ½ in. wood are then cut to the shape shown at *V*, Fig. 3. A piece of sheet tinned ir n 17 in. long about 13 in. wide is then nailed to the pieces *V* and W.

Two pieces of ½ in. wood are then cut to the shape *X*, as shown by the dotted line in Fig. 2, and a piece of tin 19 in. long and 4 in. wide is nailed to them; the whole then being fastened in the space back of the piece *W*, with the lower edge at the opening in the right side previously mentioned.

The portion of the back just above the runway just described is uphol-tered with strong cloth and cotton wool, and another piece of tin or a piece of wood about 5 in. wide is placed at an angle, as shown in Fig. 3, forming a hood to catch the balls and direct them to the runway.

When everything is finished, as above mentioned, a coat of paint or varnish is given the whole, and the swings numbered with large numbers at the top ends. The numbering is as follows: 5 3-1-3-5, the outer swings having the highest values, owing to the possibility of not hitting any. The balls used may be of wood if noise is not objectionable, but cheap base balls will serve nearly as well and make but little noise when striking the swings.

TURBINES ON THE LUSITANIA.

The Cunard liner "Lusitania" has been designed for a speed of 25 knots an hour, a speed which is a knot and a half in excess of that of the fastest of the existing ocean greyhounds, the "Kaiser Wilhelm II," of the North German Lloyd. To propel the great hull through the water at this speed the "Lusitania" is provided with turbine engines developing 63,000 indicated horse power, and driving four screws. The turbines are the largest so far constructed for similar work. The low pressure engines alone weigh nearly 430 tons. The diameter of the rotor of the latter is 15 ft. 8 in., the blades having a maximum length of 12 in. toward the low pressure end, giving a maximum diameter of the rotor of 19 ft. 4 in. The peripheral speed of the rotor under normal conditions of working will attain a maximum of 142 ft. a second. The engines have been designed with the greatest care, and in them have been incorporated the latest advance in turbine construction. Especially is this true of the casings, which have been carefully proportioned to resist circumferential stress without undue weight. By the use of the turbine, and by great increase in displacement, it has been possible to add enormously to the engine power in order to obtain the increase in speed, though this is comparatively slight in itself.

RIGIDITY OF THE EARTH.

Lord Kelvin in 1866 sought to determine the rigidity of the earth from observations of the tides of the ocean. His conclusion was that the earth as a whole is certainly more rigid than glass, but perhaps not quite as rigid as steel. The late Dr. Dawson of the Canadian Geological Survey, about 1880, concluded after carefully studying the fortnightly tides that the earth was more rigid than steel. Now Prof. T. J. J. See of the United States navy, by mathematical processes, contends that, according to Laplace s law, the density at the center of the earth is equal to that exerted by a vertical column of quicksilver as long as from St. Louis to San Francisco.

By considering the pressure throughout the whole earth, Prof. See finds that even if fluid the globe would have a rigidity greater than that of wrought iron. He finds that the average rigidity of the whole mass is nearly equal to that of nickel steel. He further contends that the rigidity of the earth's crust is about equal to that of granite, which is one-sixth that of steel, and that toward the center the rigidity rapidly increases. At the earth's center the imprisoned matter is at an enormously high temperature.

In sandstone the grains of sand are rounded, having no sharp edges as in granite.

SCIENCE AND INDUSTRY.

Hot water and steam heating systems have their respective advantages. The fuel cost is generally in favor of hot water, since the amount of heat given off by the radiator may be varied to suit the weather conditions by varying the water temperature; whereas, with steam, unless a vacuum system be used, the water must be raised to 212° F. before the radiators will become heated. Furthermore, some pressure must be generated in the system in order to drive out the air which collects in the radiators. With hot water the system is noiseless, whereas with steam, unless both valves on each radiator are properly operated, water hammer will occur.

The name of Skagway, a prominent town in the early rush to the Yukon gold field, means "Home of the North Wind." The fare on the railroad from Skagway to White Horse—a distance of 112 miles—is $20 one way.

A large and fast locomotive, constructed at Munich, and now being exhibited at Nuremburg, is said to be capable of pulling a passenger train at the speed of 93 miles an hour. The German State Railway will shortly make experiments with the new locomotive for regular service on through routes.

Prof. Chas. L. Norton, of the Institute of Technology, gives the heat unit of various kinds of fuel obtainable for one cent, as follows: "Coal, $12 per ton, 23,000; wood, $10 per cord, 27,000; oil, 12 cents per gallon, 15,000; coke, $10 per ton, 24,000; gas, $1 per 1000 cubic feet, 6500."

An acetylene blow-pipe, in which oxygen is used with acetylene, has been invented. With its use a very high temperature is obtainable, owing to the absence of inert nitrogen from the flame. It is claimed that with it a rod of pure iron serves as a soldering stick, and the heat is so great that a little of the carbon in the flame unites with the iron, converting it into mild steel.

To clean gas stove burners badly incrusted with grease, boil them in strong lye water or, in very bad cases, heat them to the point of redness over a fire. In heating burners to clean them, extreme care must be used to prevent them overheating, or they will be ruined.

Mirrors are silvered with amalgams. The simplest of these is composed of one part tin and three of mercury. A better grade of amalgam consists of two parts bismuth, one each of lead and tin and four of mercury.

Recent experiments are said to have demonstrated that cadmium gives protective coatings for iron much superior to zinc, being much more adhesive and harder. Like zinc, it finally becomes tarnished, but less rapidly. It withstands the effects of acid fumes better than zinc.

When driving out bolts, where you have no protection for the thread, strike the hardest blow you can give with a heavy hammer. Light blows with a small hammer will upset or rivet the bolt ends.

To prevent lamp chimneys from easily breaking, put them in a pot of cold water over the fire and add some common table salt. Boil well and let cool slowly, then take out the chimneys and wash them well.

A fraction of one per cent of sulphur destroys the malleability of iron when hot; while the presence of carbon lowers the fusing point by several hundred degrees.

A lubricant recommended for reamers by an American mechanic is a mixture of tallow and flake graphite. With this lubricant, he says, any old, out of round, hand ground reamer works smoothly.

Amber varnish is amber heated with linseed or nut oil and thinned when cool with turpentine. It is insoluble, hard, tough, and of permanent color. It dries slowly and forms an excellent mixture with copal varnishes, making them hard and more durable.

A substitute for platinum for use in electrical appliances is a new alloy consisting of 16½ ounces silver, 4½ pounds nickel, ½ ounce bismuth and 53 pennyweights gold. The cost of these ingredients is approximately $73.55, while an equal quantity of platinum is worth $2162.83.

The alloy of gold with mercury is known as amalgam. Mercury alloys with gold with great avidity, this being due not only to the marked affinity of the metals, but also to the fact that mercury is a metal which exists in the molten state at an ordinary temperature.

The task of separating the diamonds from the blueground in South Africa requires months. From the shaft the ore is conveyed to what are called the "floors"—great stretches of ground cleaned off like a tennis court. The ore is taken there in trucks or cars, which are fastened 10 feet apart to an endless cable, propelled by the power from the engine room. Each floor is 400 feet square, but their combined territory covers a great area of land, one mine alone having "floors" which extend five miles.

These "floors" are nothing more than the dumping grounds. Upon their smooth surface is spread the blueground to a depth of about 10 inches. Being very susceptible to the action of air and water, the blueground disintegrates after being exposed six months and is beginning to become pulverized. The harrowing is done by steam plows drawn back and forth over the "floors" by a cable. Any of the blueground that is not decomposed by the long exposure is taken to the crushing machine, where it is pulverized. All the pulverizing blueground is taken to the pulsator or separating rooms.